EFH mandates. This will most likely be the continued trend unless the MSA reauthorization weakens EFH protections.

8.2 Biological Impacts on Scallops

Impacts on scallop biology, yield, and management are related to the combined effect of many alternatives. The primary effects are likely to arise from alternatives for scallop area rotation, effort allocation, habitat closures, and gear changes.

8.2.1 Projections of stock biomass, mortality, and catch

This section describes the biological projection and simulation models, including methods and assumptions. In addition, the projection results for all the rotation alternatives and criteria options are described and presented. This model, developed by Dr. Dvora Hart at the Northeast Fisheries and Science Center in Woods Hole, MA has been successfully used in recent annual framework adjustments to set TACs and day-at-sea allocations. The Scallop PDT and the Councils Scientific and Statistical Committee have reviewed the model and assumptions, which been revised to accommodate a higher degree of resolution associated with proposed area rotation policies. One limit of the model, however, is estimating the recruitment dynamics by an area size that is too small relative to the available information from the survey. In addition, the model was run in a stochastic form, accounting for annual variability in recruitment as described below. As a result, computational time also becomes an issue for doing the analysis at a finer scale of resolution.

The rotation management areas that were chosen by the PDT for purposes of analysis have been retained throughout the amendment, although the boundaries of the areas may be modified based on public comment. The PDT has advised that reasonable boundary changes (size, configuration, number of areas) will not significantly alter the long-term steady-state results. Over shorter periods, however, significant boundary changes and the size of area closures that start the rotation program will dictate downstream results. The effects of these potential changes on yield and management when rotation management areas re-open to fishing in 2007 or 2008 will have to be re-analyzed during the framework adjustment process, based on updated information and hopefully more detailed data from cooperative industry surveys that augment the R/V Albatross resource-wide annual survey.

Because of these issues, it is not currently possible to run the rotation management area projections and simulations for flexible boundary, adaptive rotation management alternative (Section 5.1.3.2). Based on analysis of survey sampling error, the PDT thinks that flexible area boundaries could increase sustainable yield by an additional five to ten percent compared with a fixed boundary area rotation system. With both fixed and flexible rotation management area boundaries, strong year classes of small scallops will be protected. The flexible boundary system may be advantageous, however, with respect to not closing areas that are older than optimum size (i.e. older scallops populations loose biomass from natural mortality rate exceeding the growth rate) and with respect to closing areas with parts of strong year classes of small scallops that might not otherwise close because of a partial overlap with a fixed boundary area.

8.2.1.1 Introduction

The simulation model used in Amendment 10 is an extension of the model used to project abundances and landings in Frameworks 12/13/14 (see the 2000 Scallop SAFE Report [NEFMC 2000]).

This model was successful in forecasting the increases in sea scallop abundance, landings, and catch rates that have been observed during the last several years.

The main extensions to the model that are new in this version include (1) division of the resources into more areas to accommodate rotational plans (2) a new stochastic recruitment submodel which takes into account spatial autocorrelation of recruitment among subareas (3) a simple "fleet dynamics" submodel, which simulates the spatial behavior of fishermen based on biomass and location and (4) rule-based closures and reopenings, based on scallop growth rates, as part of an adaptive rotation plan.

For these simulations, there were two regions, Georges Bank and Mid-Atlantic. Georges Bank was divided up into 14 subareas, 6 in the groundfish closed areas and 8 in the open areas. Mid-Atlantic divided into 9 subareas (see Map 7). This configuration allowed for simulation of a particular fixed boundary rotation plan. However, modest changes in the boundaries should not substantially affect the outcomes of the simulations.

8.2.1.2 Model Scenarios

Five non-rotational scenarios for the areas outside the groundfish closed areas were simulated. *NR-1*: A mean *F* of 0.2 in the open areas, *NR-2*: like NR-1, but with 4" rings, *NR-3*: No action, so that the Amendment 7 DAS schedule used, *NR-4*: 26000 DAS, roughly approximating the current DAS use, and *NR-5*: *F* = 0.2 in all open subareas (Table 159). The last scenario approximates Alternative 1e; area management without rotation, where the fleet dynamics model was not used because fishing mortalities are controlled by area.

Three main classes of rotational models were considered. In the two mechanical rotation simulations, areas were opened and closed according to a fixed periodic schedule (*M-1*: three years closed and then three years opened, and *M-2*: five years closed and one year opened). In the adaptive rotation strategies with fixed closure durations (AFC), areas were closed according to a growth rule criterion. For each subarea, its growth rate, i.e., the percent increase in scallop biomass in a year, excluding new recruitment, was calculated. If this growth rate was larger than a threshold, the area was a candidate for closure. A maximum percent of biomass that could be closed (at the time of closure) was specified for each run. If the total biomass of areas already closed, together with areas that are candidates for closures, is larger than this maximum, then areas were closed in order of their growth rates until the maximum is met. When an area is closed, it remains closed for a fixed duration. Table 159 lists the twelve AFC model runs. The "Strategy" column gives the closure rule (percent) followed by the number of years that a closure lasts. The "Mxcl" column indicates the maximum percentage of biomass closed in that simulation. The "Rings" column indicates the gear ring size (for the 4" simulations, 3.5" rings are used from 2001-2003, and 4" rings are used thereafter).

In the five adaptive closures and reopening (ACR) scenarios, closures are triggered by a growth rate criterion as above, and the area remains closed until the growth rate decreases below a second growth rate threshold. The closure threshold, followed by the reopening threshold, are listed under the "Strategy" column in Table 159.

Groundfish closed area access options are listed in Table 160. The following access options were analyzed. No access, access to southern part of Closed Area II only, as had been authorized in Framework 11 (F11), access to the areas reopened as part of Framework 13 (F13), and access to all portions of the groundfish closed areas. For each option, fishing the area at a constant rate of *F* = 0.1 and *F* = 0.2 was considered.

Alternative 1b calls for an adaptive rotation system as described above in the open areas, together with using parts of the groundfish closed areas as a “reservoir”. The level of access to the groundfish closed areas would depend on the expected landings in the open areas. When open area landings are expected to be below a specified target level, groundfish closed area access would be granted to bring the total landings up to the target.

This idea serves two purposes: first, to reduce the variability in landings that can be accentuated by rotation, and secondly, to increase mean landings by allowing access to productive but less sensitive portions of the closed areas, while still keeping high biomass in these areas. Two access options under this plan are considered: a mechanical rotation of the Framework 13 areas, for which one year of fishing in the Nantucket Lightship and Closed Area I access areas is follow with three years of fishing in the southern portion of Closed Area II (this pattern is used so as to match the very high productivity and size of the Closed Area II access area with the smaller productivity and size of the Nantucket Lightship and Closed Area I access areas). The other access option involves using the southern portion of Closed Area II only (as in Framework 11). Various targets between 18,000 MT and 21,000 MT were set (see Table 159, options R-1 through R-6).

8.2.1.3 Comparisons of projections using various area rotation strategies and area management criteria

Long-term results are given in Table 159 and Table 160. The baseline NR-1 alternative gives long-term mean yields in the portion of the resource outside the groundfish areas of about 15,000 MT. This yield can be enhanced by 4” rings or by area management without rotation by about 4%. Note that because of the higher efficiency of the 4” ringed dredges, area swept (and hence bycatch) in the 4” ring alternative is lower than in NR-1. On the other hand, the area management without rotation scenario NR-5 increases bottom contact time and bycatch over NR-1 by about 20%, because the lack of aggregation of effort under this plan. The “no action” (NR-3) alternative produces long-term landings slightly lower because of underfishing, while the 26000 DAS alternative (NR-4) reduces long-term yields by about 60% due to overfishing. The latter would also induce much higher levels of bottom area swept and bycatch than any of the other scenarios considered.

All the rotational alternatives modestly increase long-term yields and scallop biomass over the baseline non-rotation scenario (NR-1). However, they increase the variability of landings to a much greater extent. These landings fluctuations may make these alternatives less desirable from a socioeconomic perspective than the no rotation alternatives, even though they give slightly higher yields.

The mechanical rotation alternatives (M-1 and M-2) give good long-term yields, but like scenario NR-5, increase bottom contact time and bycatch more than they increase yields. Also, these scenarios require 50-83% of the fishing grounds to be closed at any one time, which may require some vessels to make long steams to open areas.

In the adaptive rotation alternative with fixed closure durations (AFC-1 through AFC-12), increasing the closure duration to more than three years, or increasing the maximum biomass closed to over 25% results in only slight improvements in mean yields, while considerably increasing yield variability. On the other hand, decreasing the closure growth threshold from 40% to 20% increases long-term yield while decreasing variability. Strategy AFC-6, which calls for a 20% growth rate threshold, 3 year closures, and 25% maximum biomass closed, increases yields by about 6% over scenario NR-1, while having less variation in yield than many other rotation scenarios. If in addition 4” rings are required (AFC-12), an addition 3% increase in long-term yield would be obtained, while affecting a decrease in bottom area swept and bycatch. The adaptive closures and reopening scenarios (ACR-1 through ACR-5) give slightly better yield, but considerably greater variation in yield, compared to the fixed closure adaptive rotations.

Alternative 1a (adaptive rotation with flexible boundaries) could not be directly simulated because sufficient data is not available on the small scale required in this alternative. However, the likely result of such a strategy can be inferred. Reducing the area of the rotational units has the effect of increasing the variability in recruitment in any of the units. To test the effect of this, a model rotational simulation was done where recruitment variability was increased by a factor of two. This resulted in slightly increased yields (about 1%) over the corresponding original simulation. Thus, it is probable that this alternative would have slightly greater yields than other rotational scenarios. It is likely also that it could do this with less area closed at any given time, due to the more flexible boundaries. However, this alternative would require additional costs in terms of supplemental surveys etc.

Long-term analysis of the groundfish closed area options are given in Table 160. Access to the groundfish closed areas can add (long-term) between about 10 and 20 million lbs of landings a year, on average. Even the most limited access scenario – fishing the southern portion of Closed Area II only at F = 0.1 - gives around 10 million lbs in yield annually. This option also would sweep only a minimal bottom area and have low bycatch, due to the very high level of biomass remaining in the area. Other options give more yield, but at a cost of increasing amounts of bottom area swept and bycatch.

The reservoir rotation options are effective in the goals of high landings together with relatively low variability in the landings. Because the permitted access to the closed areas is modest, the increase in area swept and bycatch because of this access is limited.

Short-term simulations of the non-rotational options are shown in Figure 45. Scenario NR-1 gives fairly steady short and long term landings of about 15,000 MT. Scenarios NR-2 (4" rings) and NR-5 (area management without rotation) improve on this yield by about 4% long-term, but reduce yield in the short term. The no-action alternative NR-3 reduces landings in the short term (due to the very restrictive Amendment 7 DAS schedule) without a corresponding long-term benefit. The 26000 DAS scenario gives good short-term landings, but reduces both landings and biomasses to a lower level than any other alternative considered here long-term.

Sample short-term simulations of sample rotational strategies are given in Figure 47. These simulations indicate a drop in landings short-term, as areas area closed without any corresponding opening, but modest increases in yields and biomasses long-term. The increase in the variability in the landings is also apparent from these graphs.

Short-terms landings for groundfish closed area access options are given in Figure 49. At F = 0.1, short term annual landings in 2003-5 range from about 9,000 MT (F11 access only), to about 13,500 MT (all areas open). At F = 0.2, short-term annual landings in 2003-5 range from 17,000 MT (F11 access only) to 25,500 MT (all areas open). Landings gradually decline to long-term steady-state levels.

8.2.1.3.1 Updated simulations using the 2002 NMFS survey

A new set of simulations were run using updated 2002 information. The new runs were restricted to the basic non-rotational options, the one adaptive rotation option that appears to give the best results (20% closure growth criterion, 25% maximum closed, and 3 year closures), and a number of groundfish closed area access options. The relative advantages and disadvantages of options not re-examined (e.g., 4" rings in the open areas) should not change with the new information. Only short-medium term results are presented, as the new information would not alter the long-term results.

The updated information used in the new projections were: (1) the 2002 NMFS sea scallop survey data, (2) continuation of the present management regime (e.g., 120 DAS for full-time vessels, with no access to the groundfish areas) until 2004, as called for under Framework 15, so that the Amendment 10 alternatives would begin with the 2004 fishing year, and (3) an increase in the current total annual DAS use from 26,000 to over 29,000 due to reactivation of effort. The actual number of DAS used by limited access vessels in 2001 was about 28,600, but there were additionally about 2 million lbs. landed by general category vessels, corresponding to the equivalent of about another thousand DAS by the limited category fleet. Thus, it was assumed that total effort (limited access + general category vessels) was about 29,600 DAS.

Figure 5 gives updated short and medium-term landings, biomass, and area swept for the open areas for three non-rotational alternatives: 29,600 DAS, effort reduction to $F = 0.2$, and no action (Amendment 7 DAS schedule), and one rotational alternative (20% closure criterion, 3 year closures, and 25% maximum closure; AFC 6 in Table 159). The rotational alternative was initialized to close the three areas recommended by the PDT in 2004 (Mid-Atlantic areas 3-4, where the 2002 survey indicated a very strong 2001 year class, which would recruit to the fishery in 2004, and Georges Bank area 2). The 29,600 DAS scenario shows steeper declines in landings and biomass than in the previous simulations, due to the extra 3,600 DAS per year, the year delay in implementing Amendment 10 and because the 2002 survey indicated poor recruitment in most scallop grounds (except in the southern Mid-Atlantic). Similarly, the other options, which involve effort reduction measures, predict less landings short-term than those indicated previously. As was the case with the previous simulations, long-term open area landings at $F = 0.2$ will stabilize at about 15,000 MT, with rotation giving slightly greater long-term landings and biomass than effort reduction alone.

The open area rotation alternative discussed above were combined with a number of possible groundfish closed area access alternatives, thereby giving comprehensive rotational fishing packages where portions or all of the groundfish closed areas are reopened while three portions of the open areas are closed in 2004. Four groundfish access options were considered: (1) reopening Closed Area I and a portion of Nantucket Lightship Area for one year (at $F = 0.4$) in 2004, followed by three years of access to the southern portion of Closed Area II (at $F = 0.2$) in 2005-2007. This four-year rotation pattern was repeated in the simulations for the following years. (2) Reopening the southern portion of Closed Area II only at a constant rate of $F = 0.2$ (as in Framework 11). (3) Reopening the portions of the closed areas fished under Framework 13, each fished at $F = 0.2$. (4) Reopening all of the groundfish closed areas to fishing at $F = 0.2$. The latter three alternatives were assumed to be continued indefinitely.

Total landings (including both open and closed areas), biomass and area swept projections for these scenarios are given in Figure 51 to Figure 53. All options that include some closed area access give fairly steady landings of 40 million pounds or more. On the other hand, the effort reduction and rotational closures in the open areas, combined with groundfish area access, would reduce total area swept to about half present levels. Thus, these options can maintain landings near their present high levels while at the same time reducing bottom contact to about half of what occurs presently. Highest landings are achieved by Option 4 (access to all areas), followed by Option 1 (rotational access to the closed areas), Option 3 (Framework 13 access) and Option 2 (access to Closed Area II-south only/Framework 11 access). On the other hand, Option 4 would sweep the most area (about 800 nm^2) in the groundfish areas, while Option 2 would sweep less than one third as much (about 240 nm^2), even though landings under Option 4 are less than twice those under Option 2. The closed area rotation Option 1 would induce only slightly more bottom area swept in the closed areas (averaging about 290 nm^2) than Option 2, while producing landings that are about 30% higher than Option 2. Option 3 (Framework 13 access) would cause greater bottom area swept than Option 1, even though Option 1 gives greater landings, because Option 1 would allow access to all of Closed Area I if none of that area was made a habitat closure, whereas Option 3 allows access to only the central portion of Closed Area I, and because Option 1 slightly underfishing the access areas, which induces a relatively large reduction in area swept compared to the small decrease in landings. Actual DAS are estimated to range from about 15,000 for rotation without groundfish area access, to around 23,000 if all the groundfish areas are accessible. Actual allocated effort could be higher because of unused latent effort and DAS closed area tradeoffs. On the other hand, it is likely that about 1000 DAS needs to be allocated to general category vessels to account for their fishing activity, thus reducing limited access days. All alternatives (other than the "status quo" 29,600 DAS option) keep fishing mortality rates at or below the current $F_{MAX} = 0.24$ threshold and maintain biomass in both regions above their respective targets.

All the alternatives indicate a dip in landings in the 2006-2007 fishing year. This is because the higher fishing mortality rate in the Hudson Canyon area would end in 2006, but the three areas that would be closed in 2004 would not reopen until 2007. A number of measures could be taken to smooth out this dip, including (a) spreading out the high harvest fishing mortality rate in the Hudson Canyon area for another year or (b) modestly increasing fishing mortality in the closed areas during that year. The latter possibility would be permissible under the new "time-averaged" overfishing definition, and would especially be appropriate with Option 1, because the time-averaged fishing mortalities in the access areas would be below 0.2 long-term under this option (this essentially an implementation of the "reservoir rotation" alternative, where groundfish closed area access is varied in order to smooth out landings variations).

Table 159. Steady state (long-term) simulation results

	Strategy			Minimum ring size (in)	Mean biomass (g/tow)[1]	Biomass standard deviation (g/tow)[1]	Mean GB biomass (g/tow)	Mean GB open area biomass (g/tow)	Mean MA biomass (g/tow)	Mean scallop ladings (mt)[2]	Scallop landings standard deviation (mt)[2]	Mean meat count[2]	Landings per day-at-sea used[2]	Used days-at-sea[2]	Total area swept (nm^2)	Area swept per mt	Mean percent of biomass closed	Mean closure duration
	Non-rotational scenarios																	
NR-1	F=0.2, No rotation, status quo			3.5	13732	4047	23554	5573	5228	14945	2314	17.2	2314	14559	2334	0.156	0	
NR-2	F=0.2, No rotation, status quo			4	14237	4064	23884	6188	5884	15561	2397	15.2	2397	14267	1996	0.128	0	
NR-3	No action (13411 DAS)			3.5	14995	4423	24581	7488	6696	14620	1511	16.0	2410	13358	1843	0.126	0	
NR-4	26000 used DAS			3.5	10542	3984	21289	1352	1237	10211	2901	30.6	867	26096	9124	0.894	0	
NR-5	Uniform F=0.2			3.5	13895	4050	24170	6722	5603	15644	2513	16.2	2206	15099	2751	0.176	0	
	Mechanical rotation																	
M-1	3yr closed, 3yr open			3.5	14362	4073	24299	6962	5759	15962	3030	15.6	2238	15624	2751	0.172	~50	3
M-2	5yr closed, 1yr open			3.5	14615	4086	24504	7343	6052	16198	4247	15.9	2000	17822	2751	0.170	~83	5
	Adaptive rotational closures with fixed closure duration																	
	Closure: Minimum annual biomass growth (% increase)	**Closure duration**	**Maximum percent of biomass closed**															
AFC-1	30%	3	25%	3.5	13996	4112	24009	6421	5297	15696	4207	16.0	2314	14850	2435	0.155	14.8	3
AFC-2	30%	3	50%	3.5	14009	4090	24195	6767	5414	15767	4857	15.9	2317	14879	2451	0.155	17.0	3
AFC-3	30%	3	100%	3.5	14027	4097	24012	6428	5348	15791	5229	15.8	2317	14883	2463	0.156	17.9	3
AFC-4	40%	3	25%	3.5	13913	4077	23958	6326	5215	15528	4017	16.3	2305	14751	2404	0.155	8.7	3
AFC-5	25%	3	25%	3.5	14050	4117	24050	6498	5362	15815	4151	15.9	2317	14948	2462	0.156	19.5	3
AFC-6	20%	3	25%	3.5	14085	4079	24061	6519	5448	15855	3935	15.8	2315	15005	2489	0.157	24.8	3
AFC-7	15%	3	25%	3.5	14142	4066	24058	6512	5557	15841	3547	15.8	2307	15065	2469	0.156	29.9	3
AFC-8	10%	3	25%	3.5	14193	4073	24053	6502	5656	15825	3254	15.8	2296	15137	2555	0.161	34.0	3
AFC-9	30%	4	25%	3.5	14051	4091	24104	6599	5348	15822	4924	16.0	2306	14978	2480	0.157	19.2	4
AFC-10	30%	5	25%	3.5	14129	4116	24195	6767	5414	15807	5702	16.0	2292	15000	2521	0.159	23.3	5
AFC-11	30%	3	25%	4	14428	4090	24304	6971	5878	16169	4251	14.4	2430	14697	2118	0.131	14.8	3
AFC-12	20%	3	25%	4	14532	4089	24360	7075	6022	16304	4100	14.3	2432	14560	2072	0.127	22.6	3

Strategy				Minimum ring size (in)	Mean biomass (g/tow)[1]	Biomass standard deviation (g/tow)[1]	Mean GB biomass (g/tow)	Mean GB open area biomass (g/tow)	Mean MA biomass (g/tow)	Mean scallop ladings (mt)[2]	Scallop landings standard deviation (mt)[2]	Mean meat count[2]	Landings per day-at-sea used[2]	Used days-at-sea[2]	Total area swept (nm^2)	Area swept per mt	Mean percent of biomass closed	Mean closure duration
Adaptive rotational closures and re-openings																		
	Closure: Minimum annual biomass growth (% increase)	**Re-open: Maximum annual biomass growth (% increase**	**Maximum percent of biomass closed**															
ACR-1	40%	25%	25%	3.5	13866	4061	23836	6098	5235	15462	4005	16.3	2300	14750	2406	0.156	6.9	2.6
ACR-2	30%	15%	25%	3.5	14297	4067	23988	6382	5371	15887	3811	15.6	2258	15487	2756	0.173	17.0	4.0
ACR-3	30%	15%	25%	4	14432	4090	24250	6870	5931	16161	5291	14.4	2415	14602	2117	0.131	13.8	3.9
ACR-4	20%	10%	25%	3.5	14233	4120	24124	6635	5669	15955	6593	15.9	2260	15379	2725	0.171	27.3	5.3
ACR-5	20%	10%	25%	4	14627	4133	24396	6169	7143	16434	6678	14.3	2373	15099	2320	0.141	25.0	5.1
Adaptive rotational closures, fixed closure duration (all 20-3-25 [AFCD-6 or 12]), with groundfish areas used as a stabilizing "reservoir"																		
	GB area access		*TAC (mt)*															
R-1	F11(CL2-S)		18000	3.5	12546	4066	20762	6527	5433	18229	2341	15.2	2400	16750	2552	0.140	24.8	3
R-2	F11(CL2-S)		18000	4	13019	4052	21129	7079	5997	18560	2513	13.8	2507	16316	2172	0.117	24.8	3
R-3	F11(CL2-S)		19000	4	12636	4013	19531	7073	6014	19103	2373	13.8	2516	16734	2192	0.115	24.8	3
R-4	F13*		20000	3.5	11586	4023	18693	6527	5433	19608	2074	15.1	2416	17899	2677	0.137	24.8	3
R-5	F13*		20000	4	12886	4052	19202	7079	5997	19937	2200	13.7	2526	17397	2269	0.114	24.8	3
R-6	F13*		21000	4	11541	3924	17944	7079	5997	20829	2524	13.8	2411	18174	2734	0.131	24.8	3

*Mechanical rotation in closed areas: NLS+CL1 fished 1/4 years, with CL2-S fished 3/4 years

[1]Resource-wide biomass calculated under the assumption that the open areas are uniformly fished at F=0.2 (NR-5, alternative "1e")

[2] Groundfish closed areas only

Table 160. **Groundfish closure area access options**

Access	F	Minimum ring size (in)	Mean biomass (g/tow)[1]	Biomass standard deviation (g/tow)[1]	Mean biomass in GB groundfish areas (g/tow)l[2]	Mean scallop ladings (mt)[2]	Scallop landings standard deviation (mt)[2]	Mean meat count[2]	Landings per day-at-sea used[2]	Used days-at-sea[2]	Total area swept (nm^2)[2]
None	0	NA	13895	4050	44382	0	0	NA	NA	0	0
F11 (Cl2-S)	0.1	4	11013	2434	28615	4764	4815	12.3	2939	3571	120
F11 (Cl2-S)	0.2	4	10077	1811	24260	5125	6144	14.6	2647	4204	238
F11 (Cl2-S)	0.1	3.5	10392	2298	28085	4740	4766	13.3	2839	3686	140
F11 (Cl2-S)	0.2	3.5	9450	1660	23707	4993	5942	16.2	2522	4316	279
F13	0.1	4	10490	2409	26182	5508	4843	12.3	2912	4159	181
F13	0.2	4	9408	1774	21145	5922	6177	14.6	2591	4755	361
F13	0.1	3.5	9851	2271	25569	5479	4794	13.3	2812	3604	211
F13	0.2	3.5	8762	1619	20507	5769	5973	16.2	2468	5081	421
All	0.1	4	8646	2340	17605	8291	4916	12.3	2849	6389	404
All	0.2	4	7019	1658	10037	8931	6267	14.5	2478	7826	806
All	0.1	3.5	7939	2196	16679	8246	4866	13.3	2749	6590	473
All	0.2	3.5	6304	1490	9074	8700	6061	16.2	2361	8016	940

[1]Resource-wide biomass calculated under the assumption that the open areas are uniformly fished at F=0.2 (NR-5, alternative "1e")
[2] Groundfish closed areas only

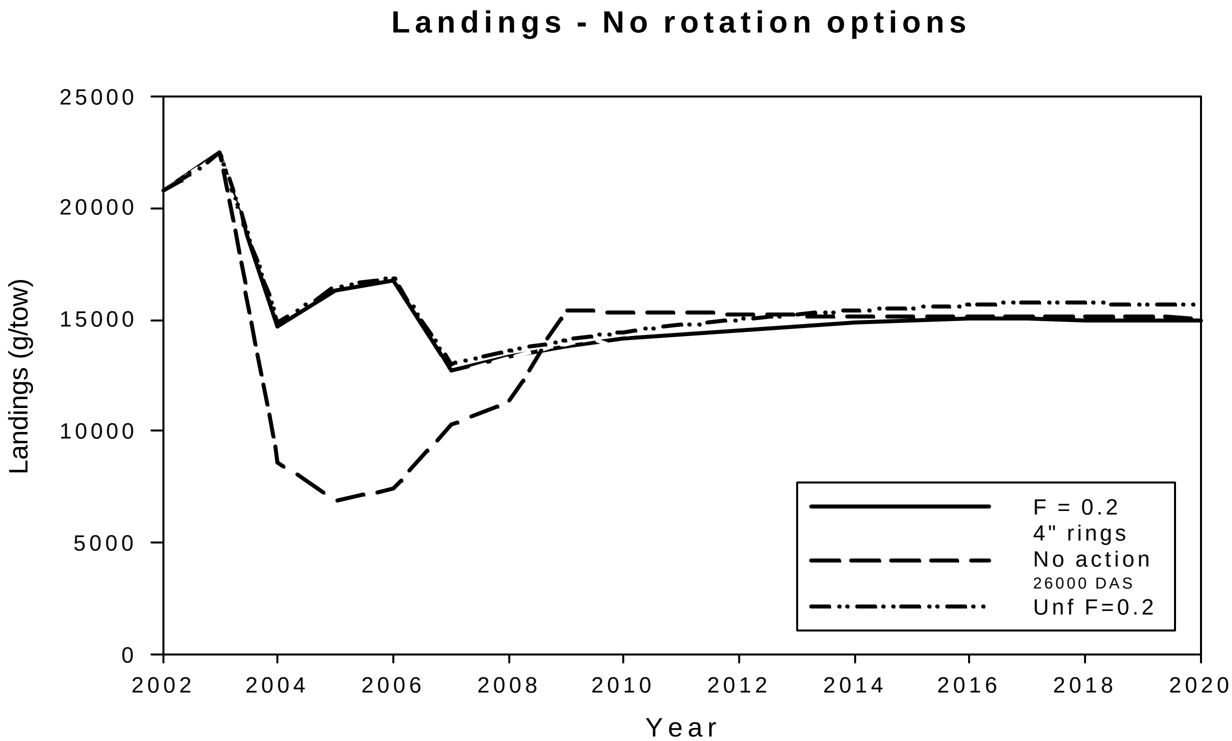

Figure 45. **Comparison of landings without rotation or Georges Bank closed area access**

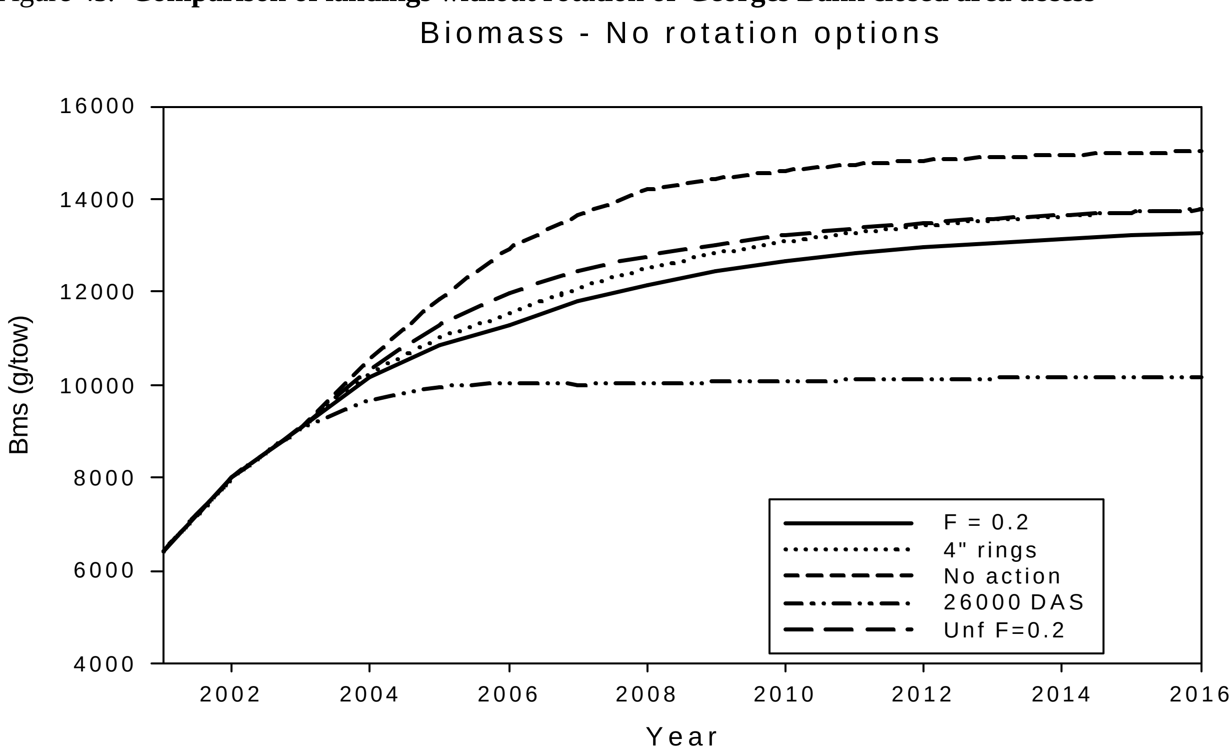

Figure 46. **Comparison of total mean biomass (Georges Bank and Mid-Atlantic added) for no rotation and without Georges Bank closed area access**

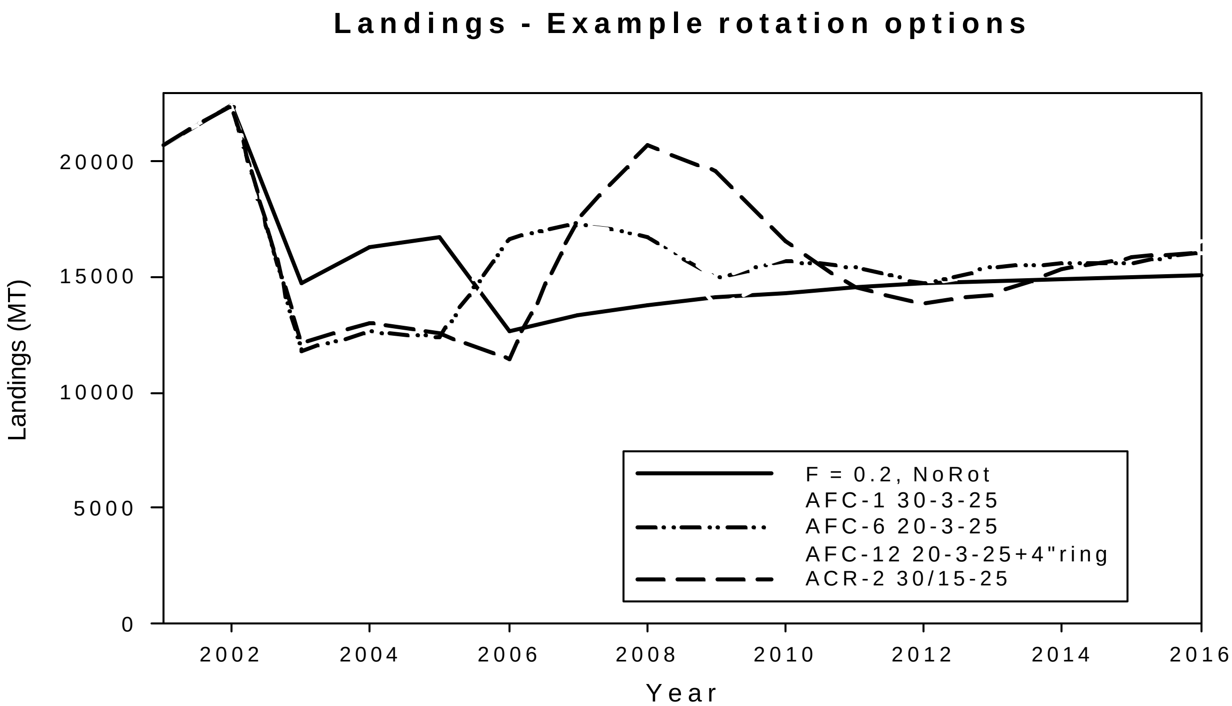

Figure 47 Comparison of annual yield projections for sample area rotation strategies

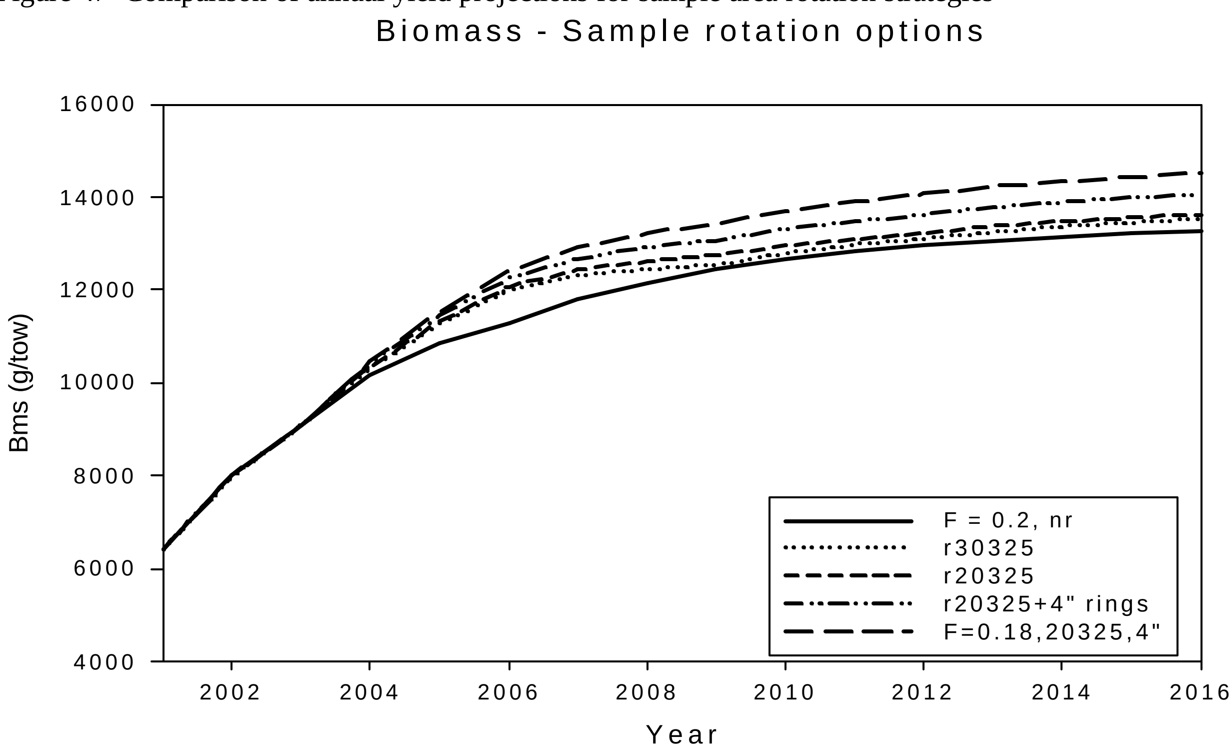

Figure 48. Comparison of annual total biomass (Georges Bank and Mid-Atlantic added together) for sample area rotation strategies

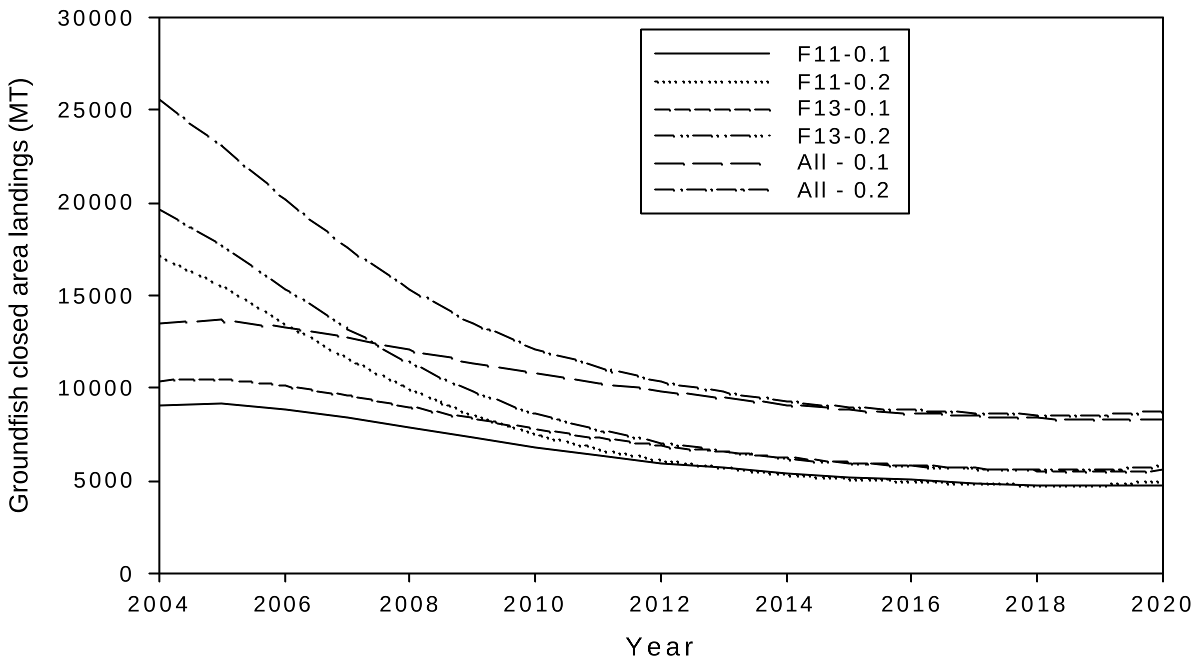

Figure 49 **Projected landings for groundfish closed access areas. Numbers in legends indicate target fishing mortality rate.**

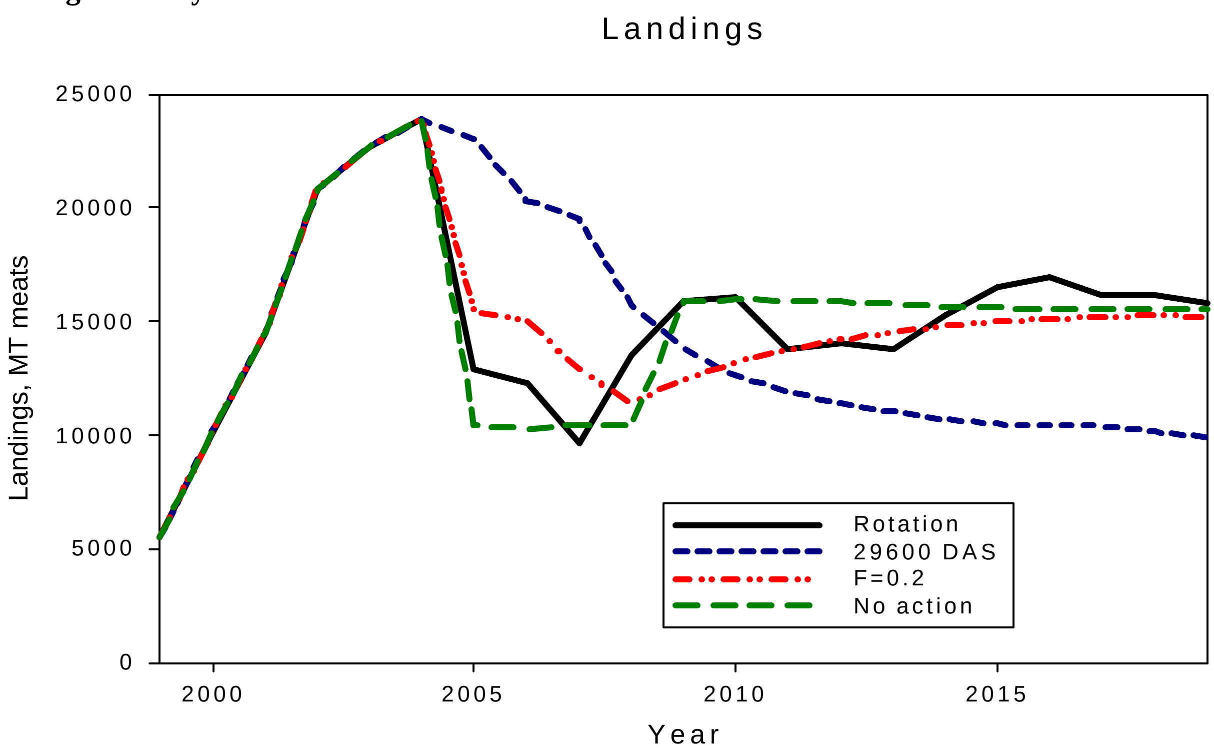

Figure 50. **Updated landings projections, assuming no access to groundfish closed areas**

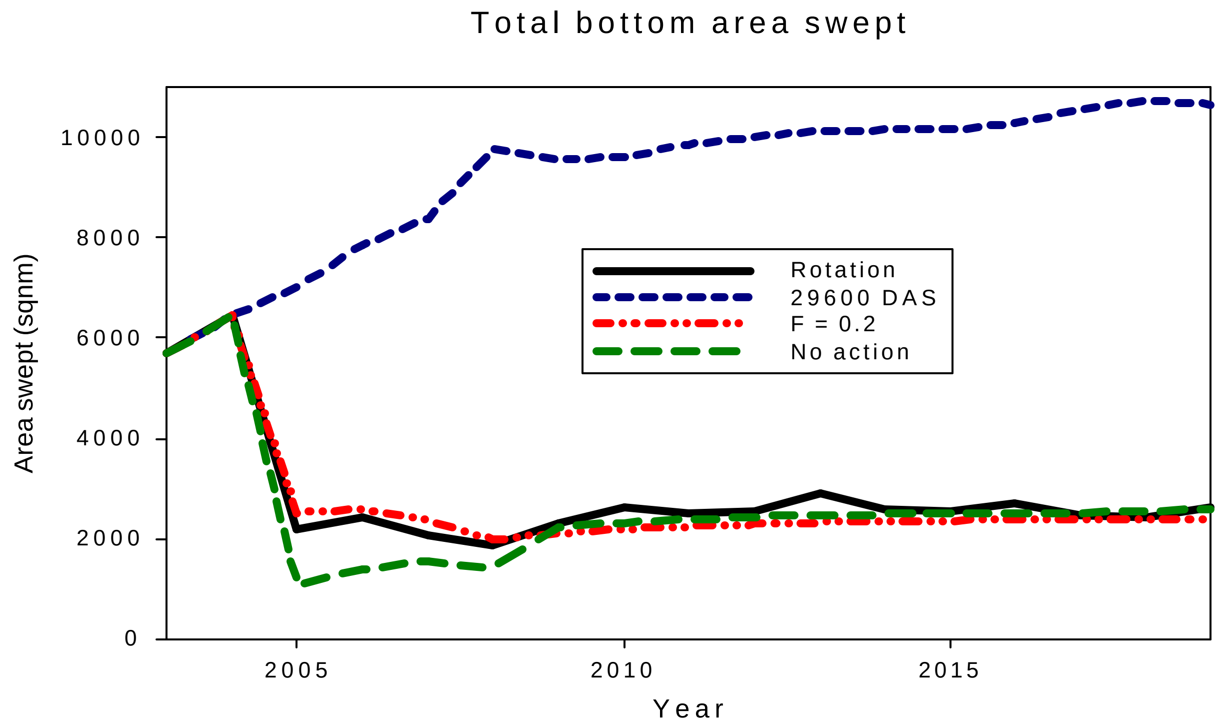

Figure 51. **Updated projections of total bottom area swept by fishing, assuming no access to groundfish closed areas**

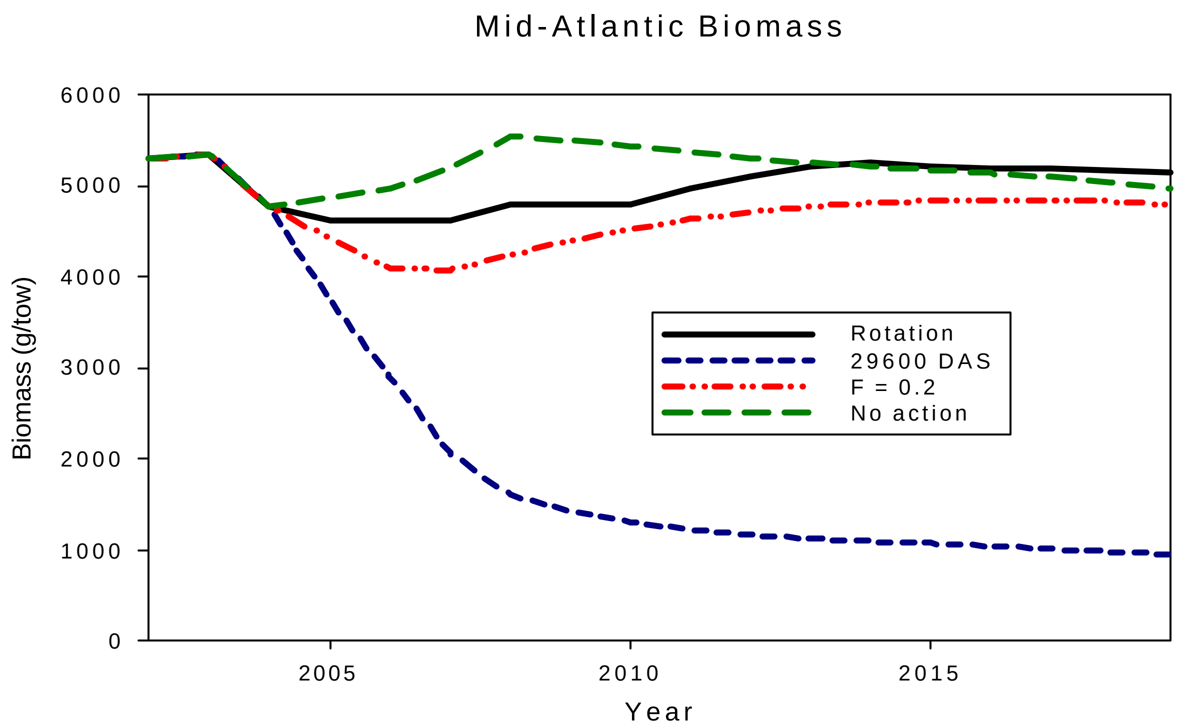

Figure 52. **Updated projections of Mid-Atlantic biomass per tow. Rotation assumes a closure when the expected biomass growth is greater than 40%, total biomass in closed rotation areas is not more than 25%, and areas close for a constant three year period.**

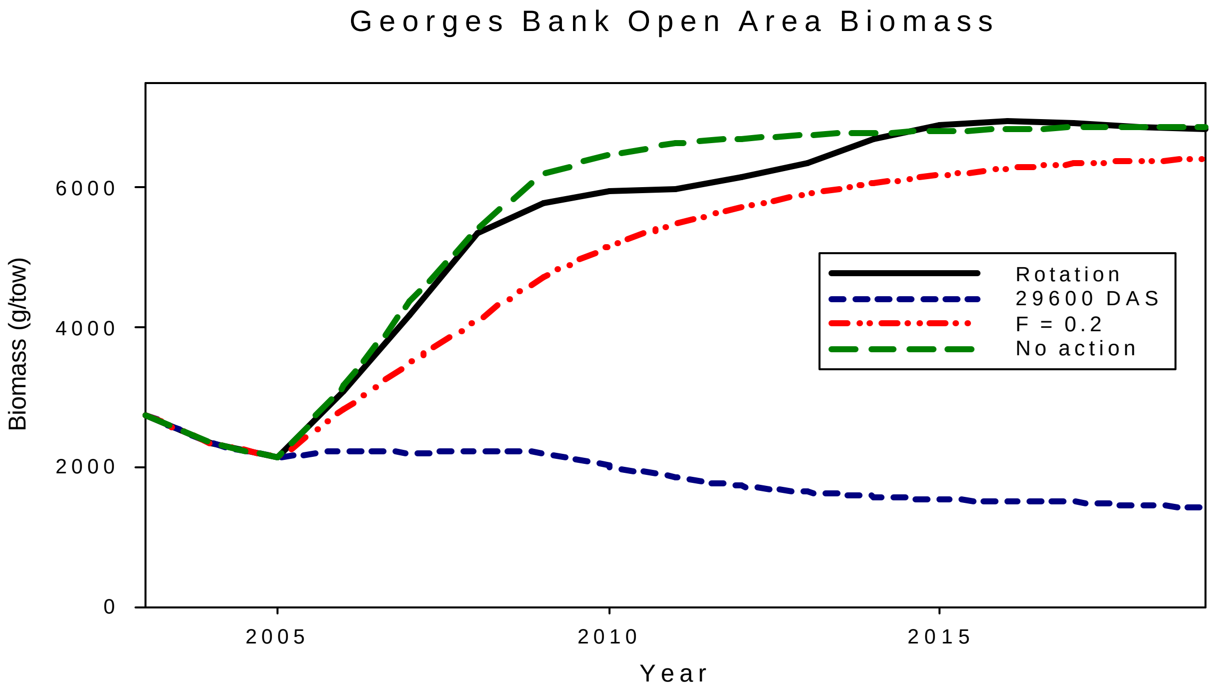

Figure 53. **Updated projections of Georges Bank biomass per tow, not including scallop biomass in the Georges Bank groundfish closed areas. Rotation assumes a closure when the expected biomass growth is greater than 40%, total biomass in closed rotation areas is not more than 25%, and areas close for a constant three year period.**

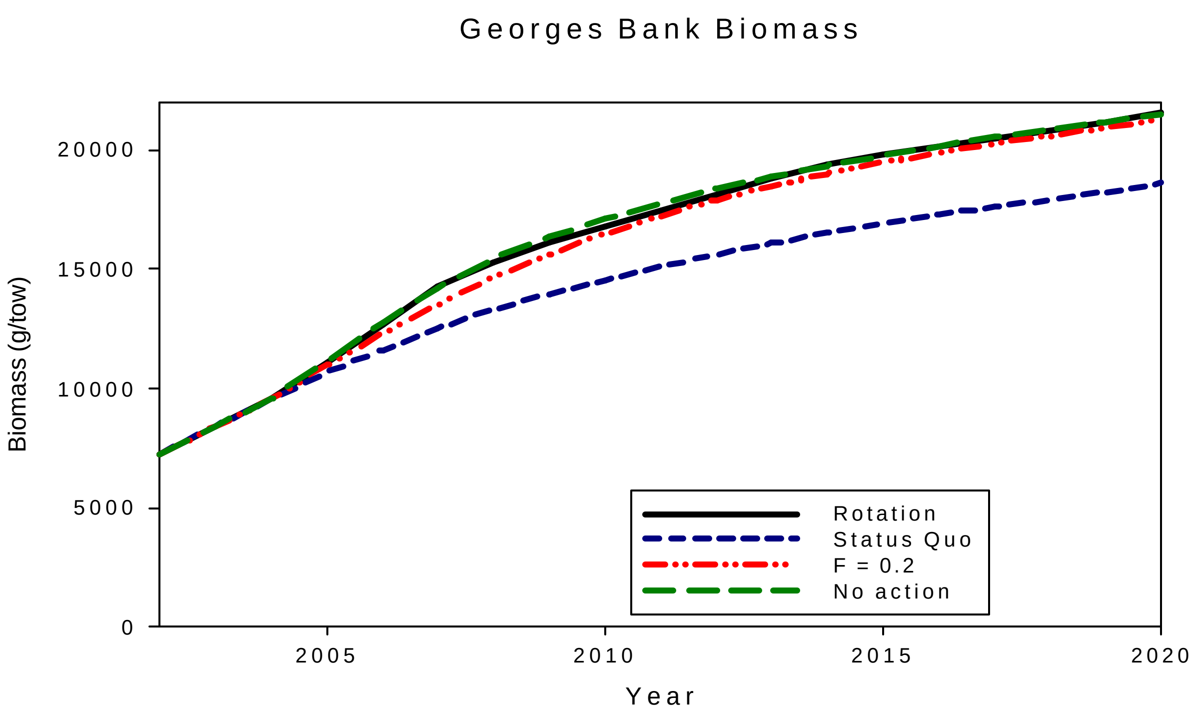

Figure 54. **Updated projections of Georges Bank biomass per tow, including scallop biomass in the Georges Bank groundfish closed areas. Rotation assumes a closure when the expected biomass**

growth is greater than 40%, total biomass in closed rotation areas is not more than 25%, and areas close for a constant three year period

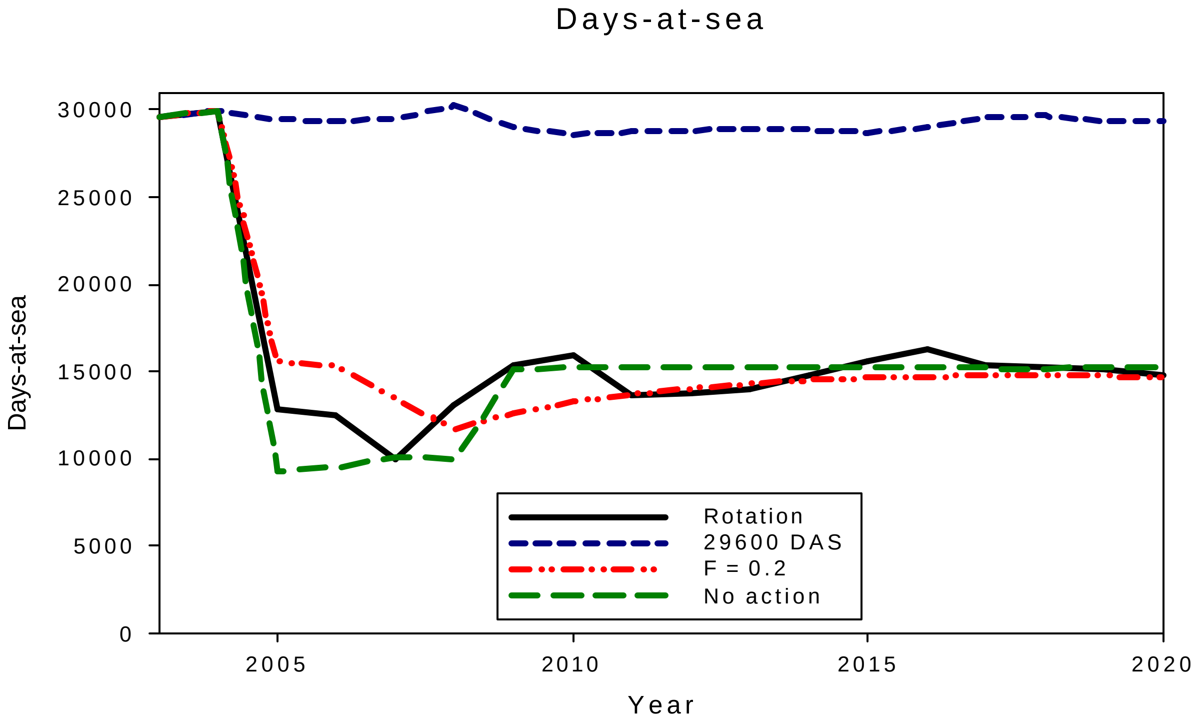

Figure 55. **Total day-at-sea use projections (including 1,000 day-at-sea equivalent for general category fishing), without access to the Georges Bank closed areas**

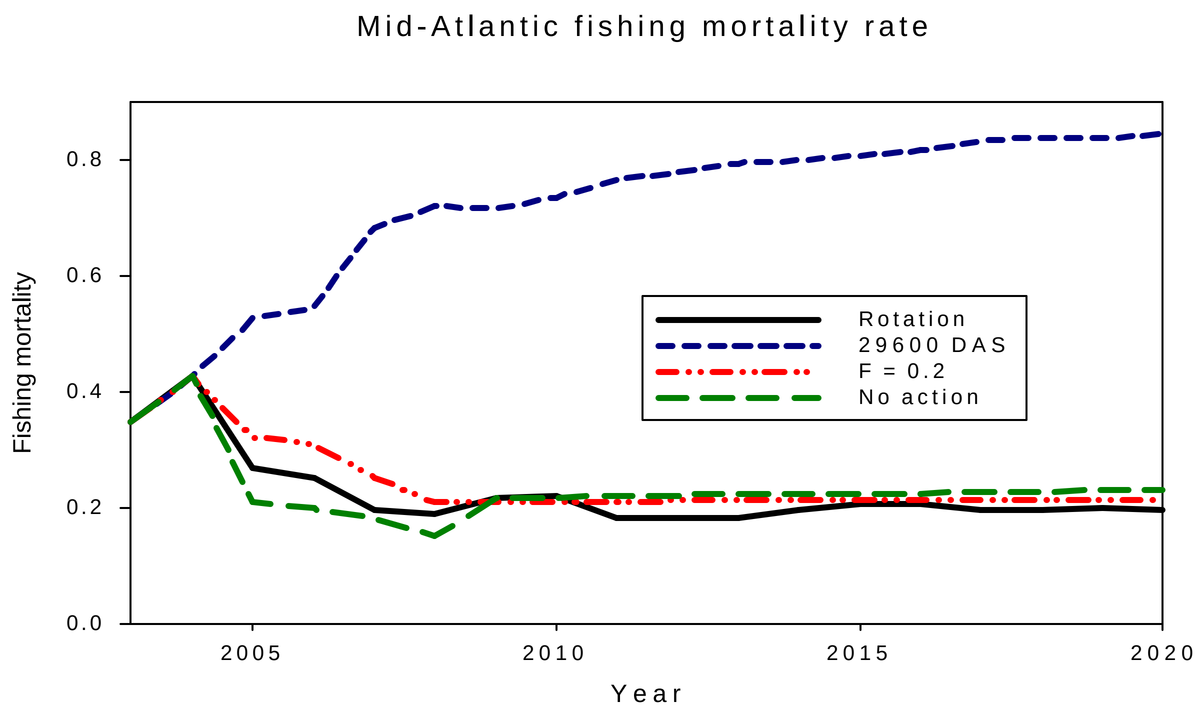

Figure 56. **Projected fishing mortality rates for Mid-Atlantic sea scallops**

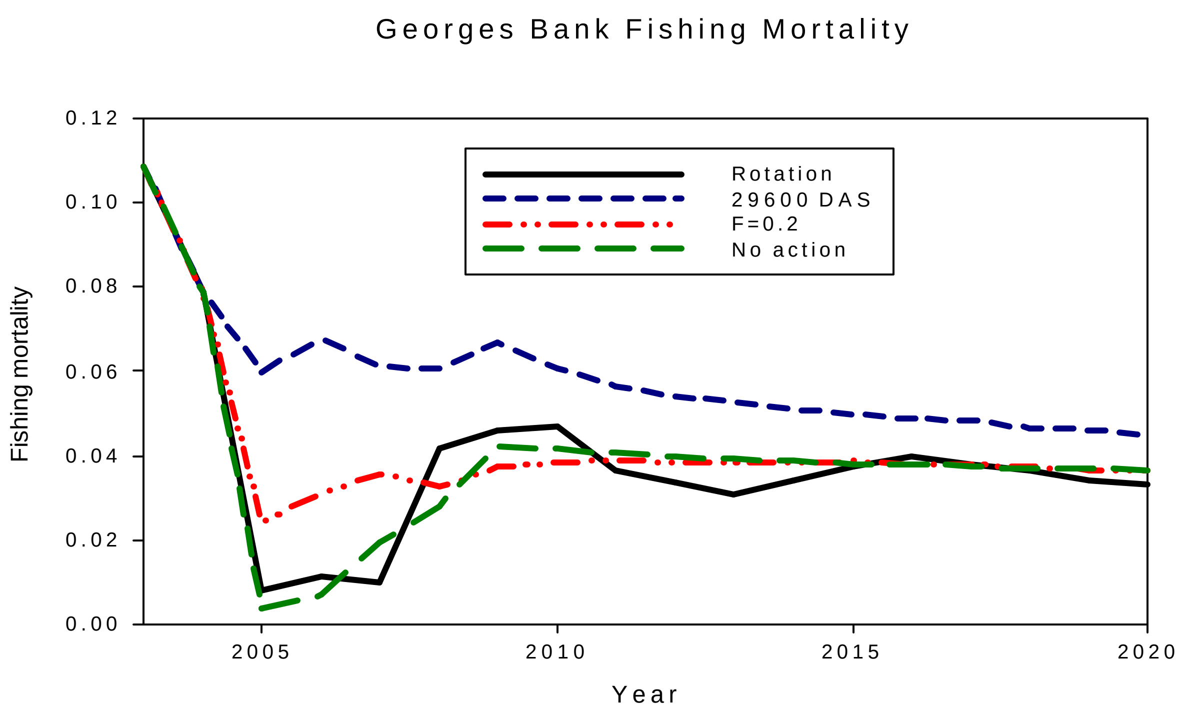

Figure 57. **Projected fishing mortality rates for Georges Bank sea scallops, with no access to the Georges Bank groundfish closed areas**

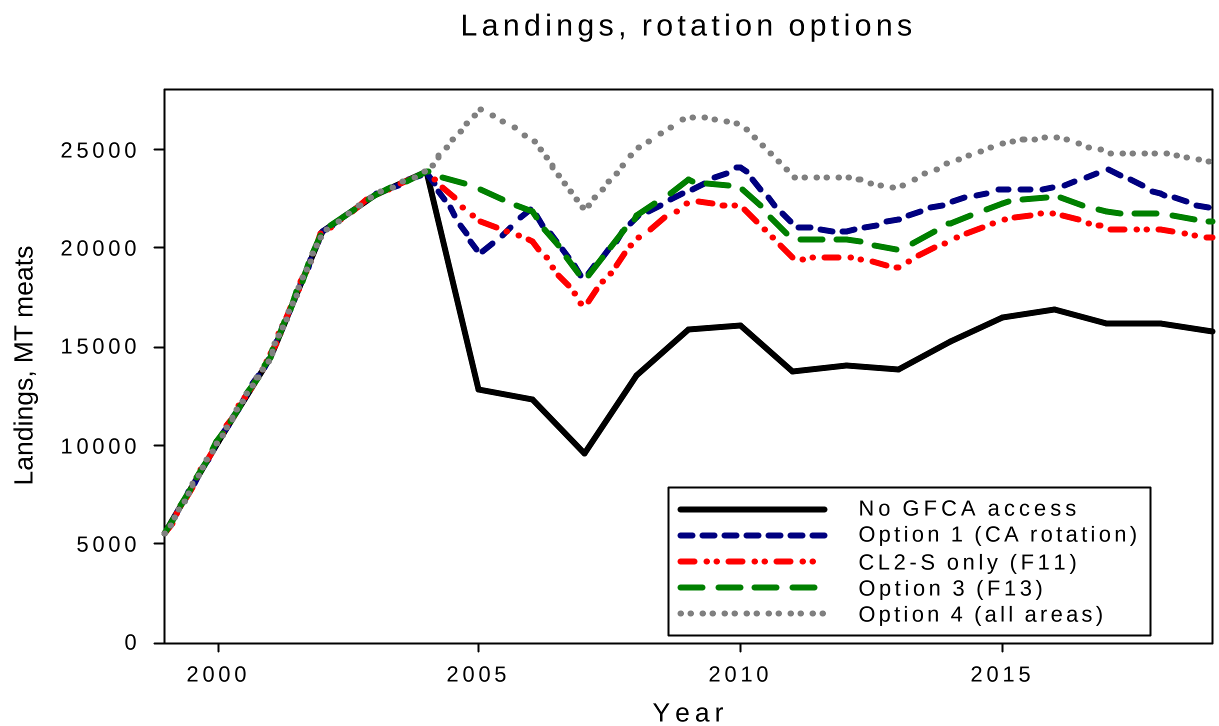

Figure 58. **Comparison of projected landings with area rotation and various options for accessing the Georges Bank groundfish closure areas**

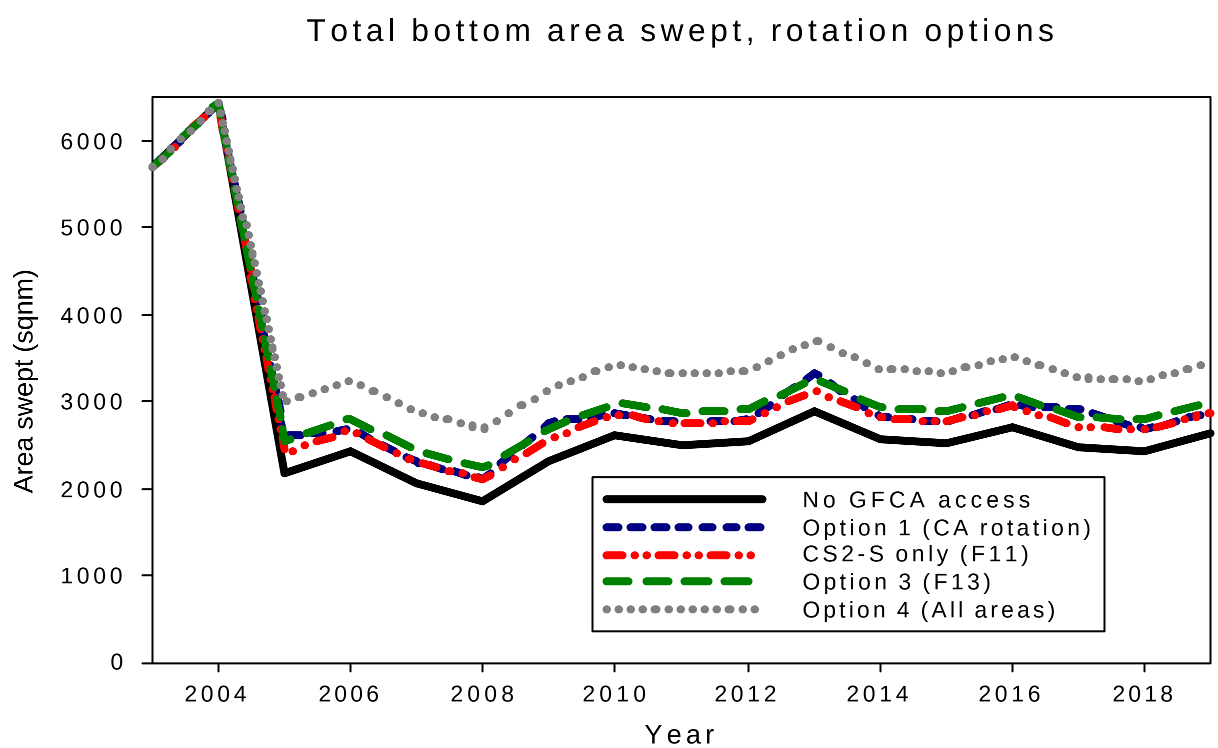

Figure 59. **Comparison of projected total bottom area swept for area rotation and various options for accessing the Georges Bank groundfish closure areas**

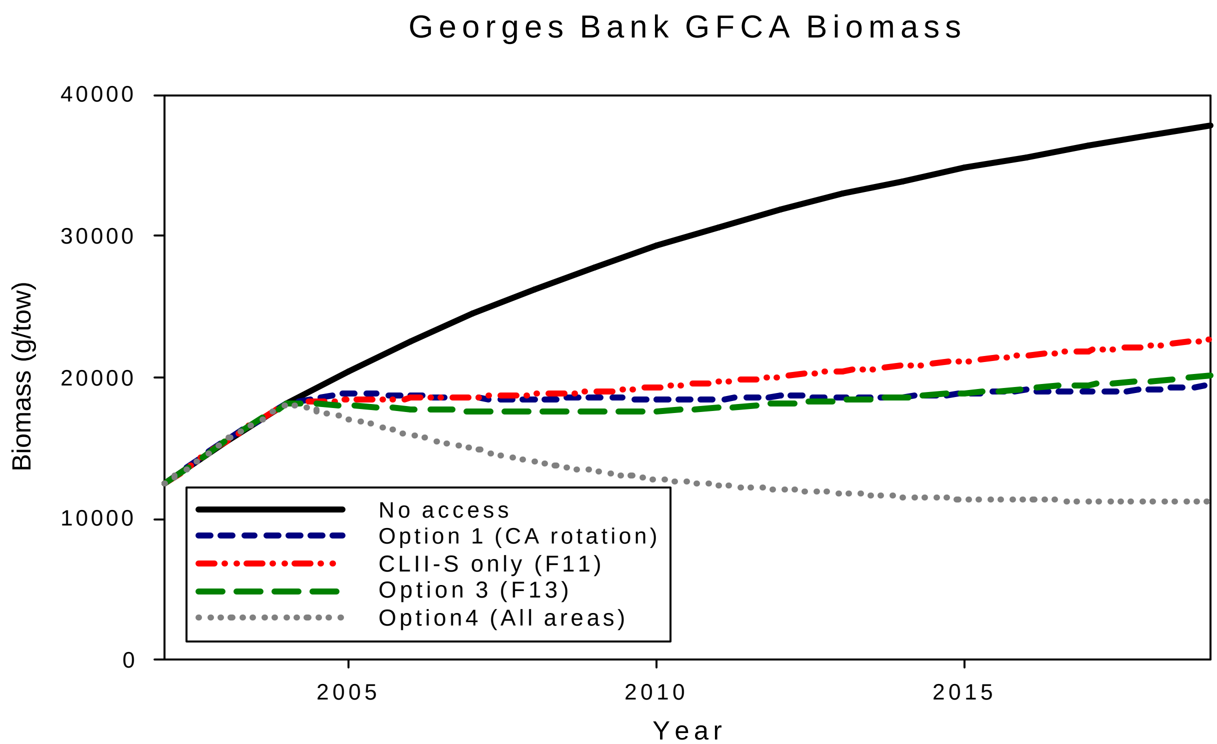

Figure 60. **Comparison of projected scallop biomass per tow in the Georges Bank groundfish closed areas versus various options for accessing the Georges Bank groundfish closure areas**

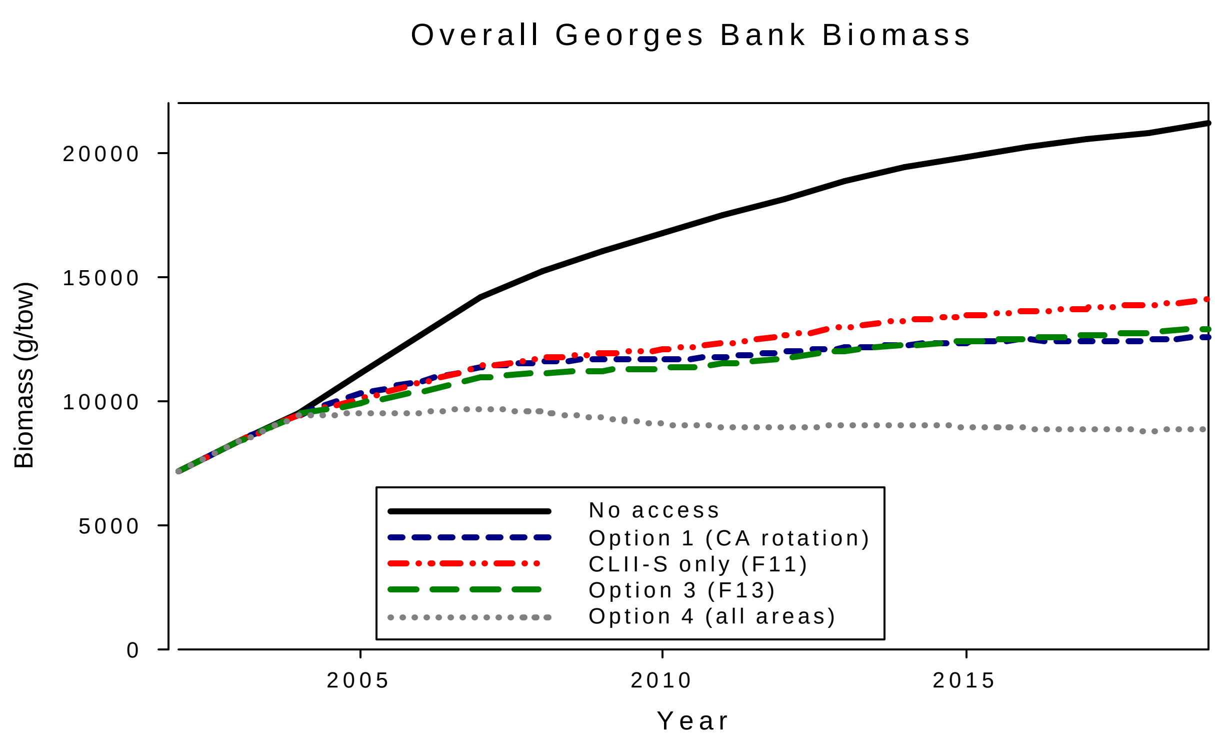

Figure 61. **Comparison of projected total scallop biomass per tow for area rotation and various options for accessing the Georges Bank groundfish closure areas**

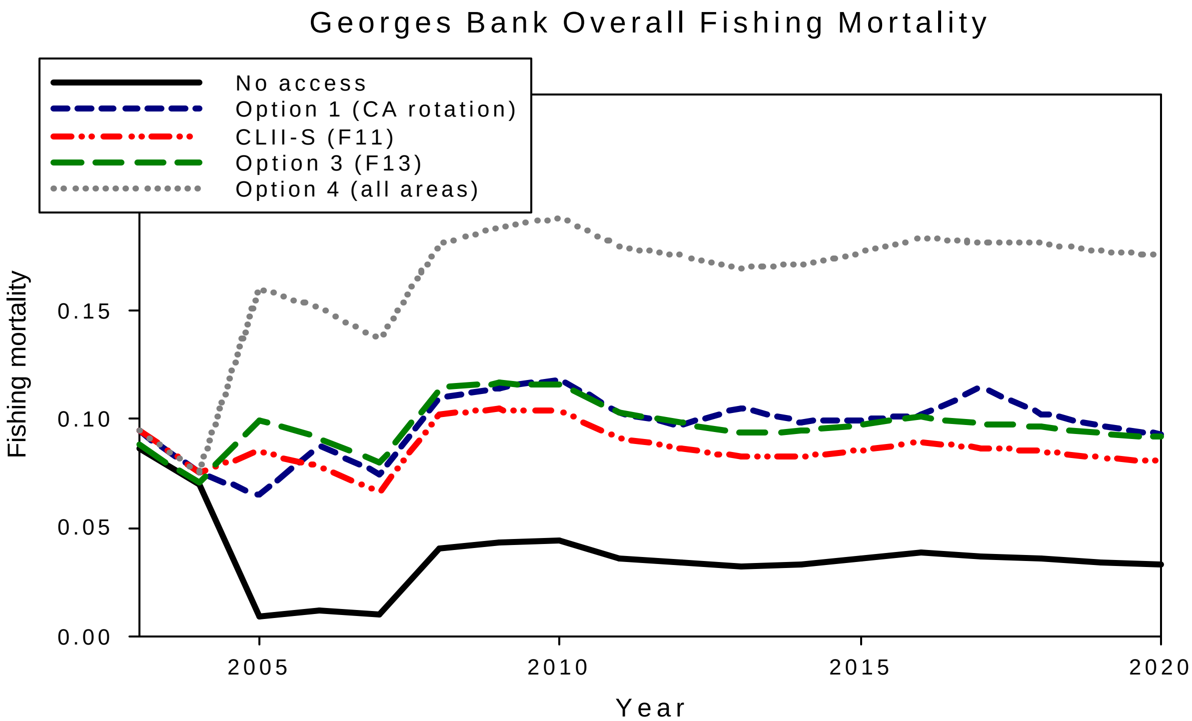

Figure 62 **Comparison of projected fishing mortality rates with area rotation and various options for accessing the Georges Bank groundfish closure areas**

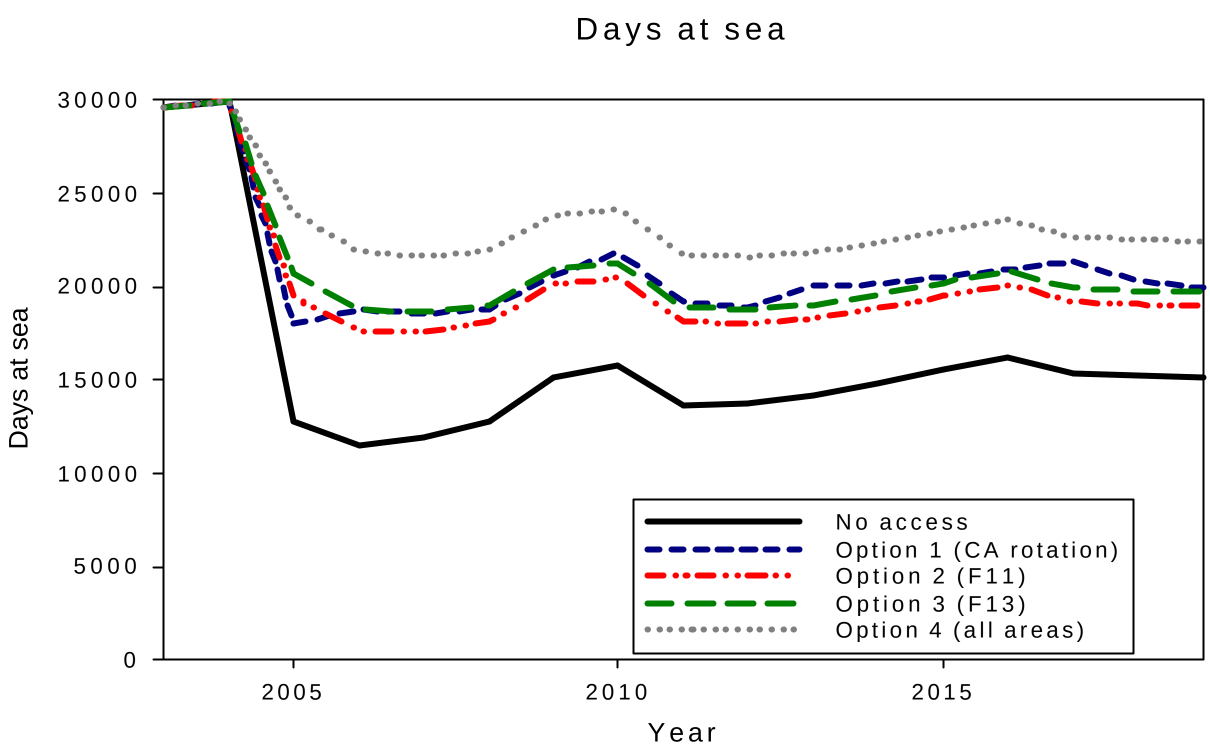

Figure 63. **Comparison of projected total day-at-sea use with area rotation and various options for accessing the Georges Bank groundfish closure areas**

8.2.2 Overfishing Definition: Status quo vs. proposed

The biomass target is the biomass expected to occur based on equilibrium yield-per-recruit calculations when the stock is fished at Fmax. The value of Bmax estimated in Amendment 7 using 1982 to 1997 data was 8.2 g/tow for scallops on Georges Bank and 4.1 g/tow for scallops on the Mid-Atlantic shelf. Amendment 10 would update these targets using 1982 – 2002 recruitment data, revising the Georges Bank target to 5.30 kg/tow and the Mid-Atlantic target to 6.26 kg/tow.

In 2002, scallop biomass was very close to the existing biomass targets for Georges Bank and for the Mid-Atlantic. Updating the biomass reference points will have little effect at this time, because current scallop biomass in both areas exceeds the existing or the proposed minimum biomass threshold.

8.2.2.1 Important differences between the status quo and proposed overfishing definitions

The existing, status quo overfishing definition and the proposed overfishing definition are the same, except in three important ways. The biomass targets for scallops on Georges Bank and the Mid-Atlantic shelf are the same for both, including the average survey biomass index derived from scallops in open and closed areas. The biomass thresholds[61] in the old and proposed overfishing definitions differ, because the proposed overfishing definition would raise the threshold from ¼ of the B_{MSY} target to ½ of that target. Under both definitions, Amendment 10 will update the recruitment data through the 2002 survey to re-estimate the value of B_{max}. Bmax is the expected stratified mean weight per tow if scallops were uniformly fished at F_{max}, the equilibrium mortality rate that would maximize yield-per-recruit.

The fishing mortality target and threshold[62] is also the same for both, derived from an equilibrium yield-per-recruit calculation (Thomson and Bell, 1934) to determine a rate of fishing that maximizes yield from a year class. This method was extended and made applicable to area rotation and sea scallop growth by Hart (in press). Due to absence of any evidence that indicated any stock-recruit relationship (except at extremely low biomass levels, obviously), the Council's Overfishing Definition Review Panel recommended using this equilibrium yield-per-recruit parameter, F_{max}, as an acceptable proxy for F_{MSY}. Details about the structure and the basis for the biomass and fishing mortality reference points for scallops are given in Applegate et al. (1998).

The Overfishing Definition Review Panel estimated the rebuilding potential for Atlantic sea scallops and based on this analysis, recommended using $\frac{1}{4}B_{MSY}$ as the minimum biomass threshold. According to the National Standard 1 guidelines, the minimum biomass threshold should be the greater of $\frac{1}{2}B_{MSY}$ or the minimum biomass that can be rebuilt in 10 years. Assuming logistic growth and $F_{max} = 0.24$, the Panel estimated that under equilibrium conditions that scallops could rebuild from $\frac{1}{4}B_{MSY}$ in 4-5 years and from $\frac{1}{2}B_{MSY}$ in 2-3 years. Due to the high fecundity and growth rate for sea scallops, the Panel

61 The biomass threshold and targets are reference points to determine when a formal rebuilding plan is needed and when rebuilding had been achieved. Theoretically, the target is also the stock biomass needed to produce MSY when fished at a maximum sustainable level.
62 The fishing mortality threshold is the level where higher amounts would be unable to sustainably produce MSY, thereby determining levels at which overfishing occurs. The fishing mortality target, on the other hand, is established to reduce the risk of overfishing due to uncertainty in the reference point estimate and in the estimate of current fishing mortality.

originally recommended ¼B_{MSY} as the minimum biomass threshold and Amendment 7 initiated a rebuilding program. Coincidentally, sea scallop biomass in both the Mid-Atlantic and on Georges Bank reached the targets in five years. Despite this, the Scallop PDT recommended using ½B_{MSY} for the minimum biomass threshold in the proposed overfishing definition, since scallop biomass is now at the target (making further rebuilding unnecessary). Although a higher minimum biomass threshold than ¼B_{MSY} may not be biologically necessary, a higher threshold would avert negative economic consequences of low stock biomass and would also better agree with the National Standard 1 guidance on the minimum biomass threshold.

Besides the change in the biomass threshold, the two overfishing definitions differ in how the fishing mortality rate is determined and judged against the fishing mortality reference points. The proposed overfishing definition is designed to maximize the yield from scallops that are or will be available to the fishery. Although the biomass level includes scallops that occur in long-term area closures, the fishing mortality rate is calculated from the proportion of exploitable size scallops that are removed by fishing from any part of the resource that is or will be available to fishing under customary or area rotation management.

The fishing mortality target, under both definitions, is set as a percent of the maximum threshold primarily to lessen the risk of overfishing the resource due to uncertainties in the reference point and in the estimation of fishing mortality. Since in theory managers want to avoid overfishing to prevent stock collapse and permanent closed areas can act as a buffer against stock collapse, the proposed overfishing definition recognizes this intrinsic value of closed areas when determining the fishing mortality target. The conservative value of the closed areas would be recognized by allowing the fishing mortality target to increase from 80 percent of the threshold (as currently exists) to 100 percent of the target when 20 percent or more of the total scallop biomass is within long-term, indefinite closed areas.

On the other hand, the status quo overfishing definition establishes a fixed fishing mortality target and threshold, to be compared with fishing mortality rates calculated from the proportion of exploitable size scallops that are removed by fishing from any part of the resource, even if those scallops would never become available to scallop fishing via a long-term, indefinite closure. The annual fishing mortality target is fixed at 80 percent of F_{max}, to lessen the risk of overfishing due to uncertainties in the reference point or the fishing mortality rate estimates.

Amendment 10 contemplates such closures to conserve critical and sensitive essential fish habitat and for minimizing overall habitat impacts. Obviously, the calculation would include zero removals from closed areas even if they would not contribute to future yield, allowing for higher average mortality rates on exploitable scallops. The exploitable scallops would be fished at a higher average rate that exceeds F_{max}, giving a lower yield-per-recruit. Over time the higher fishing mortality rate would cause a lower scallop biomass level in open fishing areas, lower landings and revenue, and because the fishery would catch smaller scallops, lower daily catch rates.

The proposed overfishing definition would also allow more flexibility for setting annual fishing mortality targets to meet area rotation objectives. The status quo overfishing definition establishes an unvarying threshold, used to judge whether or not overfishing is occurring. There may be times, following extensive area rotation closures that the area rotation policy would dictate a higher annual fishing mortality target, but the status quo overfishing definition would not allow the Council that flexibility. Time-average mortality calculations and procedures built into the proposed overfishing definition would allow this flexibility and improve the plan's ability to maximize yield from area rotation.

8.2.2.2 Final scallop projections with and without area rotation and Georges Bank closed area access: Proposed (status quo) overfishing definition (Section 5.1.1) vs. alternative overfishing definition (Section 3.4.1)

As the Council narrowed the choices for the final alternative, some modification and refinements in the biological projections were needed to understand how the two overfishing definitions and the minimum ring size options would perform relative to pending choices in rotation management area closures and Georges Bank groundfish closure access. In the DSEIS, biological projections were run which gave a moderately high probability of a rotation management area closure in the channel (GB2) and a larger closure area in the Mid-Atlantic (MA3 and MA4, or MA4 and MA7). Additional analyses and evaluations since the DSEIS publication have modified the number and configuration of the initial rotation management area closures (see Section 8.2.5). In these scenarios, only MA4 was assumed to close under rotational management beginning in 2004.

Secondly, although the initial rotation analyses focused on scallop management in open areas, much of the rest of the document assumed that Georges Bank area access would begin on March 1, 2004 in one of four area/rotation options, or not at all (status quo). Additional projection analysis was needed to improve the comparison of the overfishing definitions without the initial Georges Bank access program and applying the selectivity and dredge efficiency assumptions for 4" rings.

And although a comparison of the performance of the status quo and proposed overfishing definitions were made in the DSEIS, it focused on a specific set of area access options to make the comparison (rather than comparing different access options and rotational closures with both overfishing definitions). The comparison of the broad range of area rotation strategies, minimum ring size alternatives, area access options, and habitat closure alternatives were done in the context of using the proposed overfishing definition that had been recommended by the PDT and favorably reviewed by the Council's Science and Statistical Committee for use with area rotation and large, long-term closures.

In preparation for the late July Oversight Committee meetings and the August 2004 Council meeting, where the Council chose the measures for the final alternative, three pairs of biological projections were performed and reviewed by the PDT. Each pair provided a side-by-side comparison of the short and long-term performance of the status quo and proposed overfishing definitions. The status quo overfishing definition scenarios were run using an objective of achieving an annual fishing mortality rate equal to 0.2 for the total resource, irregardless of what parts were considered closed. Especially without access to the Georges Bank areas, the projections quickly failed to achieve the fishing mortality objective and after a few years an infinite amount of fishing effort could be allocated without achieving the target mortality rate because the majority of the scallop biomass would be locked up in areas with zero fishing effort and fishing mortality. Initially, an arbitrary cap of 100,000 DAS was applied to prevent the model from blowing up, which was later lowered to 38,000 DAS, equivalent to the number of DAS use associated with full-utilization of a 120 DAS allocation by the scallop fleet[63]. The fishing mortality in open fishing areas, thus increased with greater amounts of closed areas.

For the proposed overfishing definition (which the Council did not approve), the projection objective was to achieve a time-averaged fishing mortality target of 0.2 for all areas not under a long-term closure, i.e. the portions of the Georges Bank closed areas that were not open to fishing under Framework Adjustment 13, or for the baseline scenario (see below), all of the Georges Bank closed groundfish areas were excluded. Thus, the proposed overfishing definition ensures a time-averaged fishing mortality target is achieved equal to 80 percent of F_{max}.

[63] 2002 allocations of about 38,000 DAS resulted in about 31,000 DAS actually used by the fishing fleet.

The new results fall within the range of the previous projections for the preferred alternative and area access alternative 1, which were contained in the DSEIS. There was insufficient time and projection information to also merge the projection results with the habitat closure alternatives to gauge those effects too.

The tables below include the quantitative estimates of annual biomass, catch, effort, and area swept for each scenario. The tables also include a long-term mean result, which is the arithmetic mean of the last 10 years of the 30-year projection results. The annual results are themselves the arithmetic mean of 400 iterations that take into account the expected recruitment variation and its effect on rotation area management. Also included are the mean estimate for the target DAS use from all fishing areas (open and controlled access), area swept by the fleet, an equivalent full-time DAS allocation based on 2002 utilization rates and permits, average catch per DAS, as well as producer surplus and total benefits from the economic model which used the new projection data.

Three scenarios were run for each overfishing definition:

No access and no rotation closures. This scenario included controlled access management for the Hudson Canyon Area. The VA/NC Area was assumed to be open to fishing. This projection is essentially a baseline to compare with other policy choices.

Controlled access to the Georges Bank groundfish closed areas, but no rotation closures. The preferred alternative for controlled access was assumed, which would allow mechanical rotation of the three access areas. Parts of Closed Area I and the Nantucket Lightship Area would be open with a 0.4 fishing mortality target in 2004. The southern part of Closed Area II would be open with a 0.2 fishing mortality target in 2005 – 2007. The cycle was assumed to repeat in four-year blocks of time beginning in 2008.

Controlled access to the Georges Bank groundfish closed areas, and rotation closures. The preferred alternative for controlled access was assumed, which would allow mechanical rotation of the three access areas, as above.

The following rotation area management policy was also assumed:

Dredges use 3 ½ " rings in all areas
Areas close when the annual growth in biomass exceeds 25%, if the area were closed to scallop fishing.
No more than 25% of the scallop biomass would be in rotation area management closures, otherwise the areas with the highest growth rates were treated as closed.
Rotation area management closures have a fixed duration of three years.
Rotation area management boundaries were fixed and were the same as those used in the DSEIS.
No more than 38,000 days would be allocated. Some scenarios could not achieve the 0.2 fishing mortality target resource wide, even with 38,000 days-at-sea.

In addition, the following improvements were added to the DSEIS projections:

Non-random stations were added to the 2002 abundance index. These occur mainly in the closed areas and mainly affected the Nantucket Lightship Area biomass estimate, which nearly doubled, as a result.

- More consistent with the Amendment 10 optimum yield discussion for the preferred alternative, the proposed overfishing definition was run with an open area target of 0.22, instead of 0.20, which incorporated the optimum yield strategy of increasing fishing mortality up to the threshold as more of the scallop resource would be enclosed in long-term closed areas.
- Although the recruitment was assumed to return to average conditions for the projection time series, the projections were run over a wide range of recruitment ranges that were represented by the historic distribution of annual recruitment levels. The projection results are presented as the average of these stochastic simulations, similar to the analyses presented in the DSEIS.

Following the August 2004 Council meeting, two additional projections were run using only the status quo overfishing definition. At the August meeting, the Council approved continuing the use of the status quo overfishing definition to guide future management policy and require reductions in fishing mortality or rebuilding stock biomass when needed. The Council also approved a requirement for a minimum 4-inch ring beginning on Sept. 1, 2004 for the entire resource[64]. Previous analyses and DAS estimates also assumed a 9-day, 21,000 lb. controlled access tradeoff, and the Council approved a 12-day, 18,000 lb. tradeoff in September, following receipt of supplementary PDT analysis of various tradeoffs at a 1,500 lb./ DAS equivalent.

These two supplementary analyses modifications of projections 2 and 3 in the ones prepared for the August Council meeting above, but were modified to reflect the approved final alternative above, one with access to the Framework 13 areas and one without access throughout the projection duration. Although Framework Adjustment 16/39 might not allow approval and implementation of Georges Bank area access until August 2004, the projections are calculated on a survey year basis (August – July) and assumes the controlled access TACs will be taken during the survey year. No further adjustment is therefore needed to accommodate the delay in Georges Bank area access. The final projection analyses included the following two scenarios, to compared with the three pairs of projections that apply 3 ½ inch ring assumptions (see Table 161):

- No controlled access to the Georges Bank closed areas, but with adaptive area rotation to achieve a resource-wide fishing mortality target equal to 0.2, with 4-inch ring assumptions.
- Controlled access to the Framework 13 portions of the Georges Bank groundfish closed areas and adaptive area rotation to achieve a resource-wide fishing mortality target equal to 0.2, with 4-inch ring assumptions

Table 161. Summary of final projection scenarios and overfishing definitions used to evaluate final alternative options and future events. The "proposed" overfishing definition in the DSEIS was disapproved in favor of continuing the use of the status quo overfishing definition.

Management scenario	No area rotation		Adaptive area rotation	
	3½-inch rings	4-inch rings	3½-inch rings	4-inch rings
No area access	Status quo & proposed	None performed	None performed	Status quo
Controlled access to Georges Bank closed areas	Status quo & proposed	None performed	Status quo & proposed	Status quo

[64] This alternative was in the DSEIS, but most of the prior analyses with 4-inch rings assumed that they would be used in controlled access areas where scallops will be largest.

8.2.2.3 Comparative projections

Over the near term, the status quo overfishing definition would produce higher landings and day-at-sea allocations. Assuming access to considerable portions of the Georges Bank groundfish closed areas and no habitat closures, the status quo overfishing definition would produce greater benefits and would not jeopardize the productivity of sea scallops. Biomass, day-at-sea allocations, and daily catches would remain within acceptable ranges, but total area swept would increase. With no access or extensive habitat closures, the effects from using the status quo overfishing definition would be considerably more dramatic, as explained in the next section.

With a limited amount of closures and access to considerable parts (e.g. the areas open to fishing in Framework Adjustment 13, or equivalent) of the Georges Bank groundfish closed areas, the status quo overfishing definition would perform adequately with area rotation. Extreme recruitment variations and/or extensive closures could however produce undesirable results.

In general, the alternative proposed overfishing definition produces higher stock biomass and landings but would allow for fewer DAS allocations. Requiring 4-inch rings and applying a higher DAS tradeoff for controlled access, coupled with area-specific DAS allocations improves the performance of the approved status quo overfishing definition relative to the alternative overfishing definition.

Comparisons of all projection results for three short-term periods (2004, 2005-2007, and 2008) and for the long-term are given in Table 162 and Table 163, followed by a discussion with annual trend charts for the estimates of individual variables.

Although area swept projections for the alternative proposed overfishing definition show favorable characteristics in terms of their potential impacts on bycatch and habitat, the reduction in DAS carry a significant cost related to disruption in the fishery, inefficient use of capital, and community impacts. LPUE is also considerably lower for the status quo overfishing definition when 4" rings are required than for the proposed overfishing definition with 3½" rings. Initially, the LPUE differences are minor (2,328 vs. 2,157 lbs./day in 2004; Table 162 and Table 163), but become greater with time (2,387 vs. 1,260 in 2008).

Generally, there are important differences in the projections, depending on which overfishing definition is applies and whether or not there is access to the Georges Bank closed areas. Projected catches are affected by whether or not access occurs, but not significantly by the application of the overfishing definition. Catches for the status quo overfishing definition are 85-95 percent of those for the alternative proposed overfishing definition, but there are differences in size composition. Since scallops of different sizes or 'counts' are priced differently, this effects fleets revenue. At the same time, the biomass of scallops in open fishing areas is much lower for the status quo overfishing definition than for the alternative proposed overfishing definition. This reduces daily catch rates by as much as 50 percent and increases fishing costs. It also increases bottom contact time and area swept, because more of a DAS is used for fishing rather than by shucking[65].

[65] A scallop fishing vessels becomes shucking limited as exploitable scallop biomass increases, due to a seven man crew limit.

Because of the non-biological concerns, the Council preferred to use the status quo overfishing definition and tried to achieve some of the favorable effects of the alternative proposed overfishing definition by requiring the use of a 4” minimum ring size, by increasing the DAS tradeoff for controlled access, and making area-specific DAS allocations so that DAS could be applied in a way to increase yield-per-recruit.

Although by most measures, the alternative proposed overfishing definition has better biological characteristics (producing 10% greater catches with larger average scallop size in fewer DAS with much less area swept), the Council may choose lower annual fishing mortality targets for the resource or apply the fishing mortality targets to only open fishing areas in future actions. Under the revised framework adjustment mechanism and monitoring, the Council will need to consider the effect of the annual mortality targets on producing optimum yield.

Table 162. Comparison of overfishing definition performance with and without area rotation and Georges Bank area access, using 3½-inch ring assumptions and a 9-day, 21,000 lb. tradeoff.

		No Area Rotation No Access to Closed Areas					No Area Rotation Access to Closed Areas				Area Rotation Access to Closed Areas			
Hudson Canyon Area fishing mortality target Closed Area I & NLSA fishing mortality target Closed Area II target fishing mortality Controlled access scallop possession limit DAS tradeoff		0.32 Closed Closed 21,000 9	0.40 Closed Closed 21,000 9	0.48 (2005) Closed Closed 21,000 9	Open Closed Closed #N/A #N/A	Open Closed Closed #N/A #N/A	0.40 0.40 Closed 21,000 9	0.48 (2005) Closed 0.20 21,000 9	Open 0.40 Closed 21,000 9	Open 0.40 0.20 21,000 9	0.40 0.40 Closed 21,000 9	0.48 (2005) Closed 0.20 21,000 9	Open 0.40 Closed 21,000 9	Open 0.40 0.20 21,000 9
Overfishing definition	Data	2003	2004	2005-2007	2008	Long-term average	2004	2005-2007	2008	Long-term average	2004	2005-2007	2008	Long-term average
Proposed	Landings (million lbs.).	52.6	29.1	27.1	32.9	36.3	40.1	47.5	37.4	47.3	37.9	45.9	40.4	48.8
	Revenue (million 1996)	$168.4	$132.0	$125.6	$141.2	$ 148.1	$155.0	$164.1	$150.4	$ 164.4	$151.4	$162.4	$155.5	$ 166.0
	Average fishing mortality	0.27	0.13	0.10	0.10	0.09	0.16	0.16	0.13	0.14	0.14	0.15	0.13	0.13
	Target day-at-sea use	30,483	13,482	12,360	14,559	15,901	16,931	19,146	15,700	19,304	16,184	18,531	16,849	19,980
	Estimated full-time DAS allocation	120	56	54	60	65	75	82	67	79	71	79	72	82
	Landings per day-at-sea used (lb.)	1,721	2,145	2,184	2,245	2,260	2,355	2,473	2,372	2,428	2,328	2,473	2,387	2,416
	Producer surplus (million)	$134.4	$118.3	$113.1	$126.3	$ 131.7	$137.3	$143.8	$134.1	$ 143.8	$134.6	$142.8	$138.0	$ 144.7
	Total benefits (million)	$237.4	$155.7	$146.7	$172.6	$ 186.2	$202.3	$230.7	$191.9	$ 230.6	$193.6	$225.0	$203.9	$ 235.7
	Georges Bank biomass (kg/tow).	9.9	11.5	13.1	14.6	15.7	11.0	11.3	11.6	11.9	11.1	11.6	12.2	12.4
	Mid-Atlantic biomass (kg/tow)	4.8	4.6	4.3	4.5	4.6	4.6	4.3	4.5	4.6	4.6	4.4	4.6	4.7
	Combined biomass (kg/tow)	7.2	7.8	8.4	9.2	9.7	7.5	7.5	7.8	8.0	7.6	7.7	8.1	8.3
	Total area swept (nm^2).	7,493	2,687	2,472	2,630	3,098	2,730	2,516	2,589	2,912	2,812	2,562	2,740	3,189
Status quo	Landings (million lbs.).	52.6	42.4	41.4	37.1	19.3	47.7	51.6	46.5	43.3	49.8	55.7	46.3	45.9
	Revenue (million 1996)	$168.4	$157.9	$155.9	$148.4	$ 98.9	$164.7	$168.3	$163.1	$ 159.0	$166.6	$171.0	$162.4	$ 162.1
	Average fishing mortality	0.27	0.20	0.20	0.20	0.14	0.20	0.20	0.20	0.20	0.21	0.22	0.21	0.17
	Target day-at-sea use	30,483	22,481	26,086	30,288	38,009	22,229	22,654	23,219	24,913	28,203	30,367	52,276	30,985
	Estimated full-time DAS allocation	120	93	107	125	> 150	96	96	99	103	121	128	> 150	128
	Landings per day-at-sea used (lb.)	1,721	1,892	1,610	1,236	510	2,150	2,283	2,004	1,740	1,759	1,850	891	1,504
	Producer surplus (million)	$134.4	$133.7	$127.3	$114.7	$ 55.5	$140.8	$143.9	$138.0	$ 132.0	$135.5	$137.1	$100.5	$ 127.1
	Total benefits (million)	$237.4	$205.6	$196.5	$172.4	$ 74.6	$228.3	$243.2	$221.7	$ 206.9	$229.1	$249.7	$183.8	$ 210.1
	Georges Bank biomass (kg/tow).	9.9	11.2	12.3	13.3	14.0	10.8	11.1	11.4	11.5	10.9	11.3	11.8	11.7
	Mid-Atlantic biomass (kg/tow)	4.8	4.1	3.4	2.6	2.2	4.3	4.0	3.8	3.7	4.1	3.5	2.9	2.7
	Combined biomass (kg/tow)	7.2	7.4	7.5	7.6	7.7	7.3	7.3	7.3	7.3	7.2	7.1	7.0	6.9
	Total area swept (nm^2).	7,493	5,256	7,496	10,089	15,291	4,358	3,838	5,296	6,332	7,460	7,440	18,759	8,870

Maximum fishing mortality threshold (MSY)	0.24
Target fishing mortality (OY)	0.20
Target biomass (kg/tow) - Georges Bank	5.30
Target biomass (kg/tow) - Mid-Atlantic	6.26

Table 163. Comparison of overfishing definition performance with and without area rotation and Georges Bank area access, using 4-inch ring assumptions and a 12-day/ 18,000 lb. tradeoff, compared to baseline conditions without area rotation or access using 3½-inch rings.

		No Area Rotation No Access to Closed Areas					4" rings Area Rotation No Access to Closed Areas				4" rings Area Rotation Access to Closed Areas			
Hudson Canyon Area fishing mortality target		0.32	0.40	0.48 (2005)	Open	Open	0.40	0.48 (2005)	Open	Open	0.40	0.48 (2005)	Open	Open
Closed Area I & NLSA fishing mortality target		Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	0.40	Closed	0.40	0.40
Closed Area II target fishing mortality		Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	0.20	Closed	0.20
Controlled access scallop possession limit		21,000	21,000	21,000	#N/A	#N/A	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
DAS tradeoff		9	9	9	#N/A	#N/A	12	12	12	12	12	12	12	12
Overfishing definition	Data	2003	2004	2005-2007	2008	Long-term average	2004	2005-2007	2008	Long-term average	2004	2005-2007	2008	Long-term average
Proposed	Landings (million lbs.).	52.6	29.1	27.1	32.9	36.3								
	Revenue (million 1996)	$168.4	$132.0	$125.6	$141.2	$ 148.1								
	Average fishing mortality	0.27	0.13	0.10	0.10	0.09								
	Target day-at-sea use	30,483	13,482	12,360	14,559	15,901								
	Estimated full-time DAS allocation	120	**56**	**54**	**60**	**65**								
	Landings per day-at-sea used (lb.)	1,721	**2,145**	**2,184**	**2,245**	**2,260**								
	Producer surplus (million)	$134.4	$118.3	$113.1	$126.3	$ 131.7								
	Total benefits (million)	$237.4	$155.7	$146.7	$172.6	$ 186.2								
	Georges Bank biomass (kg/tow).	9.9	11.5	13.1	14.6	15.7								
	Mid-Atlantic biomass (kg/tow)	4.8	4.6	4.3	4.5	4.6								
	Combined biomass (kg/tow)	7.2	7.8	8.4	9.2	9.7								
	Total area swept (nm^2).	7,493	**2,687**	**2,472**	**2,630**	**3,098**								
Status quo	Landings (million lbs.).	52.6	42.4	41.4	37.1	19.3	42.6	35.0	24.6	33.3	50.0	52.5	47.4	46.8
	Revenue (million 1996)	$168.4	$157.9	$155.9	$148.4	$ 98.9	$158.1	$143.2	$119.2	$ 141.0	$167.1	$168.8	$164.4	$ 162.5
	Average fishing mortality	0.27	0.20	0.20	0.20	0.14	0.20	0.16	0.09	0.11	0.20	0.20	0.19	0.18
	Target day-at-sea use	30,483	22,481	26,086	30,288	38,009	24,315	37,428	37,610	37,536	23,108	26,286	38,126	37,299
	Estimated full-time DAS allocation	120	93	107	125	**> 150**	110	150	152	152	126	119	183	180
	Landings per day-at-sea used (lb.)	1,721	1,892	1,610	1,236	**510**	1,747	957	794	1,012	2,157	1,999	1,260	1,338
	Producer surplus (million)	$134.4	$133.7	$127.3	$114.7	$ 55.5	$131.7	$100.5	$ 76.2	$ 98.0	$142.1	$140.0	$120.7	$ 119.9
	Total benefits (million)	$237.4	$205.6	$196.5	$172.4	$ 74.6	$204.2	$153.5	$104.3	$ 145.5	$236.5	$242.3	$207.2	$ 204.4
	Georges Bank biomass (kg/tow).	9.9	11.2	12.3	13.3	14.0	11.2	12.2	13.6	14.6	10.6	10.8	11.2	11.4
	Mid-Atlantic biomass (kg/tow)	4.8	4.1	3.4	2.6	2.2	4.2	3.8	3.0	3.0	4.4	4.2	3.8	3.6
	Combined biomass (kg/tow)	7.2	7.4	7.5	7.6	7.7	7.2	7.4	7.7	8.1	7.1	7.1	7.0	7.1
	Total area swept (nm^2).	7,493	5,256	7,496	10,089	15,291	5,402	12,041	12,058	11,817	3,901	5,076	10,849	10,137

Maximum fishing mortality threshold (MSY)	**0.24**
Target fishing mortality (OY)	**0.20**
Target biomass (kg/tow) - Georges Bank	**5.30**
Target biomass (kg/tow) - Mid-Atlantic	**6.26**

8.2.2.3.1 Trends in Target DAS Use

The DAS use targets are calculated before applying controlled access DAS tradeoffs or making allowances for DAS utilization by the fleet. These estimates are estimated to achieve the fishing mortality target appropriate to the overfishing definition

As would be expected, the target day-at-sea use is higher for the status quo overfishing definition. With area access but not rotation area management, the annual day-at-sea target averaged 19,398 vs. 24,874 days for the status quo overfishing definition (Figure 64). Area rotation increases the target day-at-sea estimates, but introduces variability, which is much greater for the status quo overfishing definition than for the proposed overfishing definition. Using the status quo overfishing definition with 4” rings reduces the DAS targets initially to 23,108 DAS in 2004, which gradually rises and hits the 38,000 DAS projection limit by 2008.

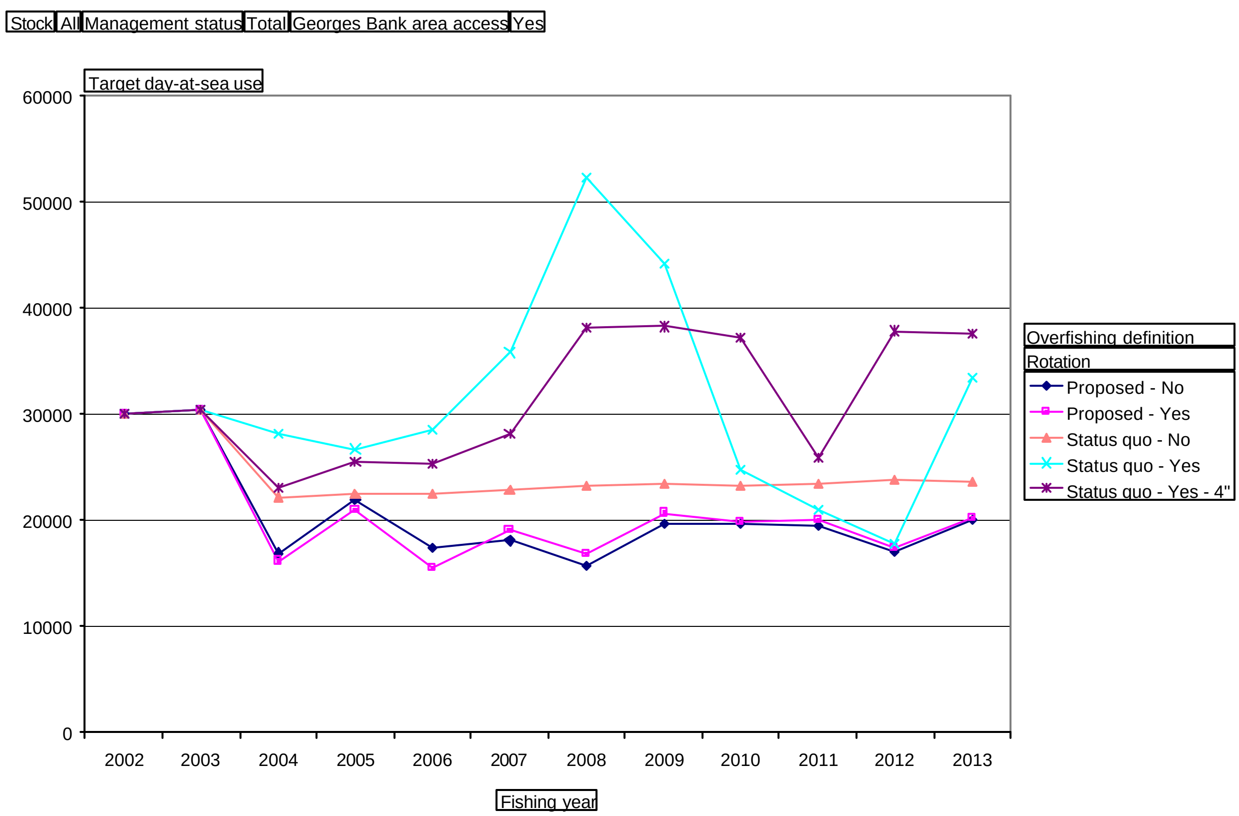

Figure 64. Comparison of overfishing definitions: Target DAS use by year with access to the Georges Bank closed areas

While the day-at-sea targets are stable for the proposed overfishing definition without access or rotation (although lower, reflecting the reduction in productivity without access), the projection for the status quo overfishing definition reaches the limit placed on the model by 2009[66] (Figure 65). Essentially

[66] Some iterations reach the limit earlier, due to variations in the projected biomass in closed areas vs. open areas.

without access, the status quo overfishing definition could allow an unlimited amount of days-at-sea without achieving the resource-wide 0.2 fishing mortality target. Using the status quo overfishing definition, other factors that define optimum yield would have to come into play to control mortality on scallops that are available to the fleet. Using 4" ring assumptions, the target DAS use would rise slightly to 24,315 DAS in 2004 and then reach the DAS limit by 2005 because of the high proportion of biomass in closed areas.

Figure 65. Comparison of overfishing definitions: Target DAS use by year with no access to the Georges Bank closed areas

8.2.2.3.2 DAS allocations

With access to the Georges Bank closed areas, the DAS allocations follow similar trends to the DAS use above. The DAS allocations with the status quo overfishing definition are higher than with the alternative proposed overfishing definition (Figure 66), the latter averaging about 70 to 80 DAS in the short- and long-term. The status quo overfishing definition with the lower DAS tradeoff and 3½ inch rings would allow a 121 DAS allocation in 2004, rising to at least 150 DAS in 2008, with a long term average of 128 DAS. Application of 4-inch rings and the higher controlled access DAS tradeoff (final alternative) allows higher DAS allocations in 2004 (126 DAS), 2008 (183), and in the long-term (180), but has a slightly lower average for 2005-2007 (119 DAS).

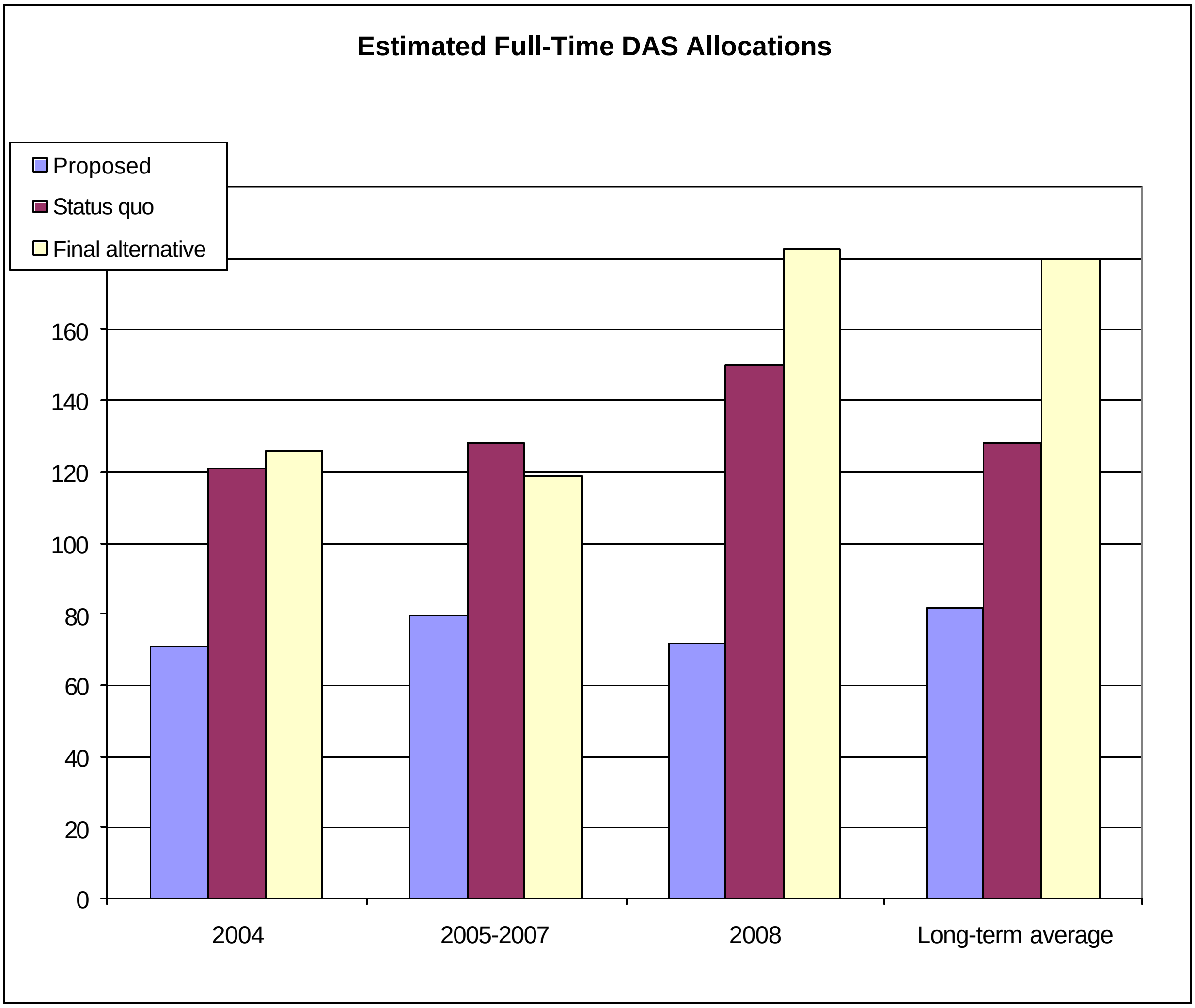

Figure 66. With Georges Bank access: Estimated full-time DAS allocations after accounting for DAS utilization in 2002 and DAS tradeoffs. The DAS tradeoffs are 9 days/21,000 lbs. for the "Proposed" and "Status quo" scenarios, and 12 days/18,000 lbs. for the "Final alternative" scenario.

Without access to the Georges Bank closed areas, the DAS allocations follow similar trends to the DAS use above. The DAS allocations with the status quo overfishing definition are higher than with the alternative proposed overfishing definition (Figure 67), the latter averaging ranging between 54 and 65 DAS in the short- and long-term. The status quo overfishing definition with the lower DAS tradeoff and 3½ inch rings would allow a 93 DAS allocation in 2004, rising to 125 DAS in 2008, with a long term average of at least 150 DAS. Application of 4-inch rings and the higher controlled access DAS tradeoff (final alternative) allows higher DAS allocations in all cases: 2004 (110 DAS), 2005-2007 (150), 2008 (152), and in the long-term (152).

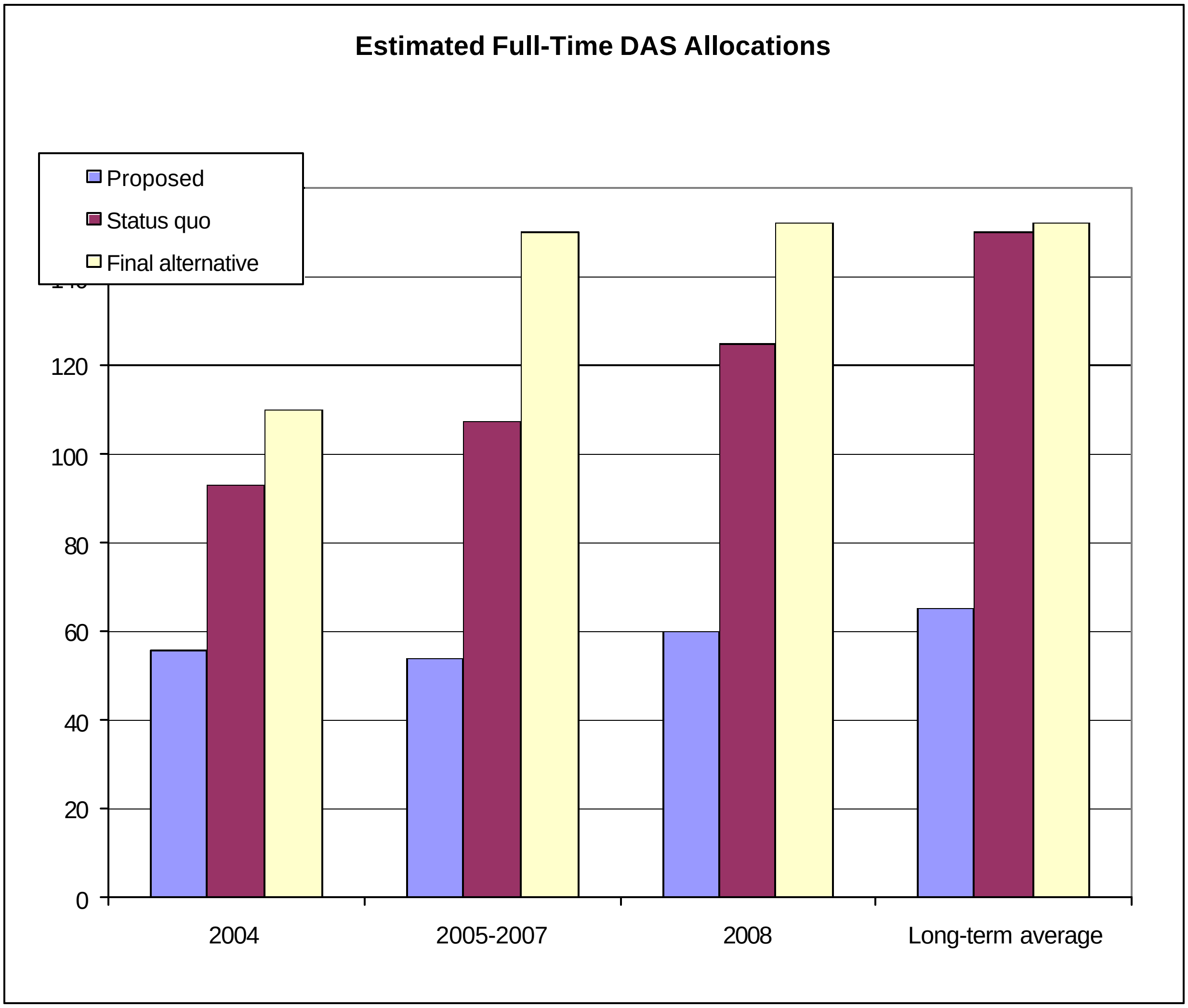

Figure 67. With no Georges Bank access: Estimated full-time DAS allocations after accounting for DAS utilization in 2002 and DAS tradeoffs. The DAS tradeoffs are 9 days/21,000 lbs. for the "Proposed" and "Status quo" scenarios, and 12 days/18,000 lbs. for the "Final alternative" scenario.

8.2.2.3.3 Trends in Fishing Mortality

The projected annual fishing mortality rates are a result of applying the overfishing definition target, combined with area rotation policy having areas open to fishing with elevated local fishing mortality targets. For re-opened areas, the fishing mortality rate is locally higher than the target – which in the short-term applies to the controlled access programs for the Hudson Canyon Area, the Nantucket Lightship Area, Closed Area I and Closed Area II. When the proposed "Elephant Trunk" area re-opens to scallop fishing (2007 assumed), the fishing mortality rate there was modeled on the basis of time-averaged, ramped mortality where the six year average from 2004 – 2010 is equal to 0.20.

The status quo and the alternative proposed overfishing definition apply the targets in different ways, however. For the status quo overfishing definition, the projections model the fishing mortality rate in the open areas so that the resource wide average is 0.20 if it can be produced with less than 38,000 days-at-sea. The peculiar aspect of this is that as more areas close to scallop fishing, the target allows higher and higher fishing mortality to be applied in the open fishing areas. This is why the PDT advice is that the status quo overfishing definition does not by itself work well with rotation area management. As more areas close, it requires more effort in the remaining open areas, potentially reducing yield-per-recruit and catch per DAS.

According to the status quo overfishing definition, the annual fishing mortality target is F = 0.2, applied to all resource areas regardless of their availability to the commercial fishery. Thus, without rotation the status quo overfishing definition projects fishing mortality declining from 0.27 in 2003 to 0.20 in 2004 and then remaining flat (Figure 68). In this case, the projections were run without constraining the DAS allocations. Other projections using the status quo overfishing definition with area rotation and access to Georges Bank areas indicate that fishing mortality for the resource would decline and then vary between 0.15 and 0.23. The use of 4" rings ("Status quo – Yes – 4"), which is the most relevant to the final alternative, reduces fishing mortality on the resource relative to 3 ½ rings where the status quo overfishing definition is applied.

In contrast, the alternative proposed overfishing definition applies a fishing mortality target to areas open to fishing to achieve maximum yield-per-recruit from the scallops that occur there. Thus, the fishing mortality rate in open fishing areas remains at 0.20, regardless of what other areas are close or are under controlled access. Time-averaged mortality rules apply to areas that re-open to fishing and the fishing mortality can vary because of that management strategy. On the other hand, the closed areas (both long and short-term) bring the overall resource fishing mortality rate down below 0.20.

For the proposed overfishing definition with access to Georges Bank areas, fishing mortality is projected to decline from 0.27 in 2003 to 0.15 in 2004, and then vary between 0.13 to 0.19 (Figure 68). It is less than 0.20 because of the zero fishing mortality in areas that never open to fishing (in this case parts of the Georges Bank groundfish closed areas). Area rotation ("Proposed – Yes") is projected to reduce overall fishing mortality slightly.

The overall fishing mortality is not that meaningful, however, to yield and the economy because it averages in zero fishing mortality in closed areas which do not contribute to landings. Fishing mortality in open areas is expected to be higher than the 0.20 MSY target, potentially reducing yield-per-recruit and catch per DAS. Obviously other management objectives will need to come into play in future framework adjustments to set annual mortality targets and produce optimum yield in the long-term.

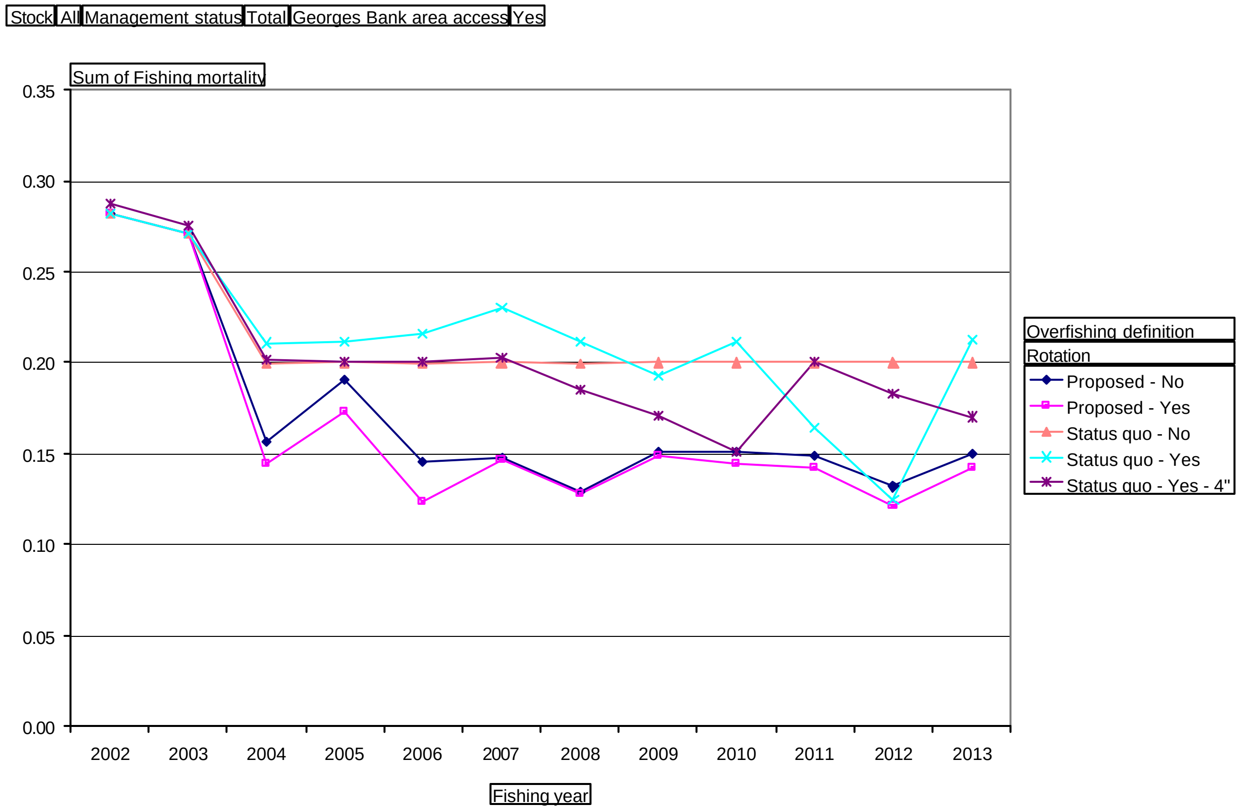

Figure 68. With Georges Bank access: Projected annual fishing mortality rates for the total resource area.

Without access to the Georges Bank closed areas, the status quo overfishing definition will allow higher fishing mortality rates than the proposed overfishing definition, even with 4" rings ("Status quo – Yes – 4"; Figure 69). Fishing mortality is projected to decline from 0.27 in 2003 to 0.20 in 2004, and then decline through 2009. For the proposed overfishing definition, fishing mortality is projected to decline to 0.13 in 2004, and then vary around 0.10 overall, reflecting the averaging of zero fishing mortality in closed areas.

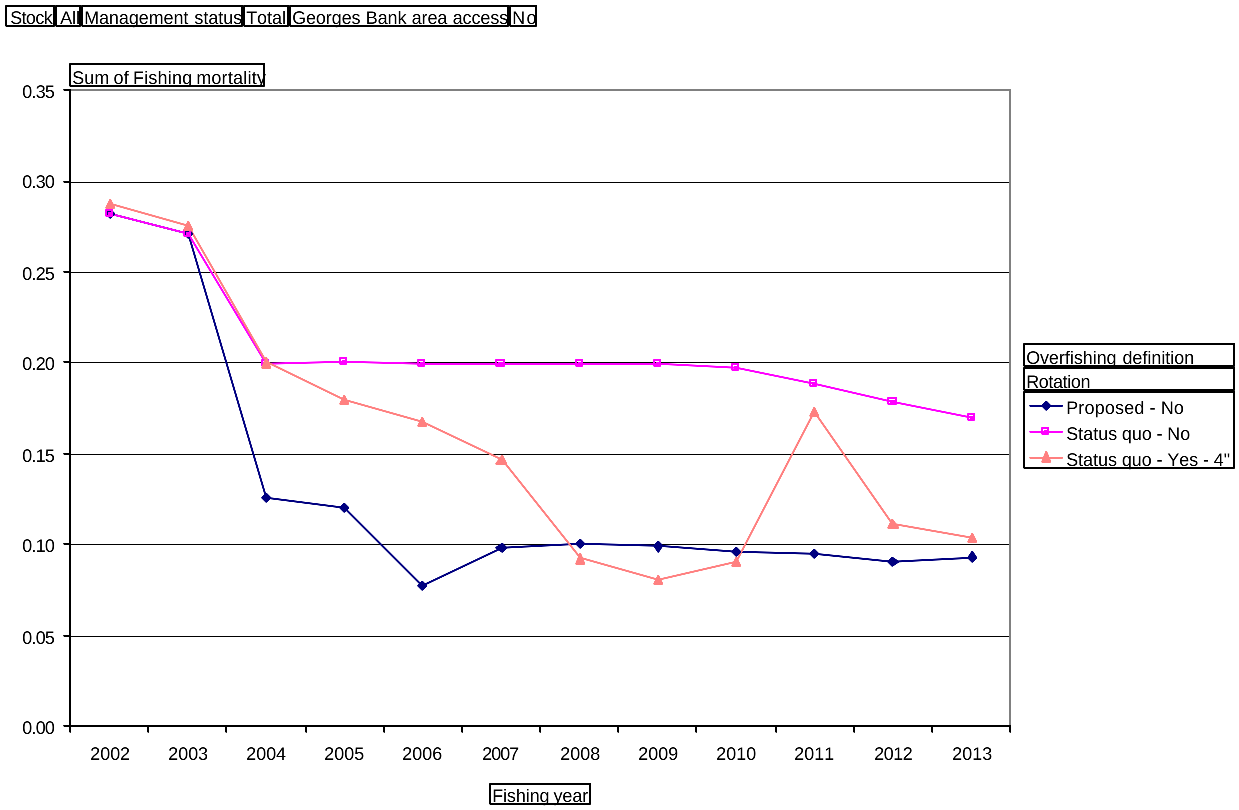

Figure 69. With no Georges Bank access: Projected annual fishing mortality rates for the total resource area.

Fishing mortality in the open fishing areas where scallops contribute to yield is much higher, however. In the open areas of Georges Bank (this excludes the controlled access areas), the status quo overfishing definition without rotation ("Status quo – No"), fishing mortality is projected to decline from 0.57 in 2003 to 0.21 in 2004, then begin climbing in 2006, reaching more than 0.30 in 2012 (Figure 70).

With rotation, the fishing mortality rate in the open areas of Georges Bank becomes more variable. In the short term, fishing mortality in the open areas of Georges Bank is expected to decline to 0.27 in 2004 and 2005, then bounce around between 0.13 and 0.40, depending on the year and rotation areas in place at the time.

Fishing mortality using the proposed overfishing definition is projected to decline more steeply to 0.07 with rotation in 2004, then stabilize around 0.18 beginning in 2007.

Figure 70. With Georges Bank access: Projected annual fishing mortality rates for open fishing areas for the Georges Bank scallop resource (excludes controlled access fishing in the Georges Bank groundfish closed areas).

For scallops in the Georges Bank area access mechanical rotation program, fishing mortality (the target is established independently of the overfishing definition) is expected to increase to 0.06 in 2004, 0.10 in 2005, then gradually decline through 2013 (Figure 71). Slight increases in fishing mortality are expected with 4" rings ("Status quo – Yes – 4"), but this will be offset by better size selection and increased dredge efficiency.

Although the fishing mortality targets for the individual areas are higher, all three Georges Bank areas are not open in the same year. These projections also are estimating the average fishing mortality rate for scallops in all of the Georges Bank closed areas, and large portions are classified as a habitat closure area. Thus, the overall average for the Georges Bank groundfish areas is considerably less than 0.20.

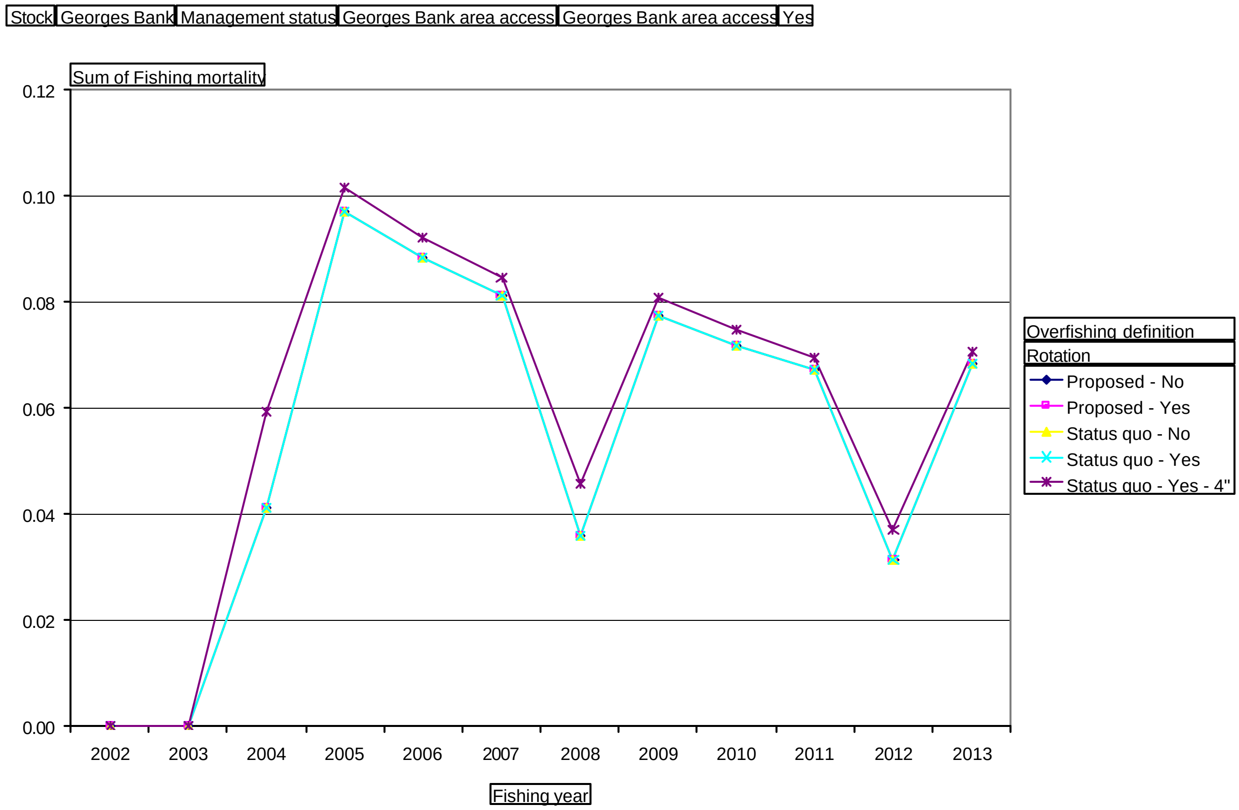

Figure 71. With Georges Bank access: Projected annual average fishing mortality rates for the Georges Bank controlled access areas (Frame work 13 portions of the Nantucket Lightship Area, Closed Area I, and Closed Area II).

The projected fishing mortality rate in the Mid-Atlantic is expected to be higher than 0.20, partly due to the effects of the status quo overfishing definition on local mortality rates and partly due to the lower fishing costs associated with fishing in the Mid-Atlantic compared to Georges Bank.

For the status quo overfishing definition with rotation and 4" rings ("Status quo – Yes – 4"; Figure 72), fishing mortality is projected to decline from 0.55 in 2003 to 0.45 in 2004, 0.41 in 2005, increase to 0.58 in 2006, then vary between 0.20 and 0.41. All are well above F_{max} (F= 0.24). Without area rotation, fishing mortality is projected to climb will above 1.0.

Applying the alternative proposed overfishing definition, the Mid-Atlantic fishing mortality rate is projected to decline to 0.32-0.33 in 2004 and 2005, then decline and remain constant around 0.22 (by definition). Area rotation is projected to cause slight decreases in Mid-Atlantic fishing mortality.

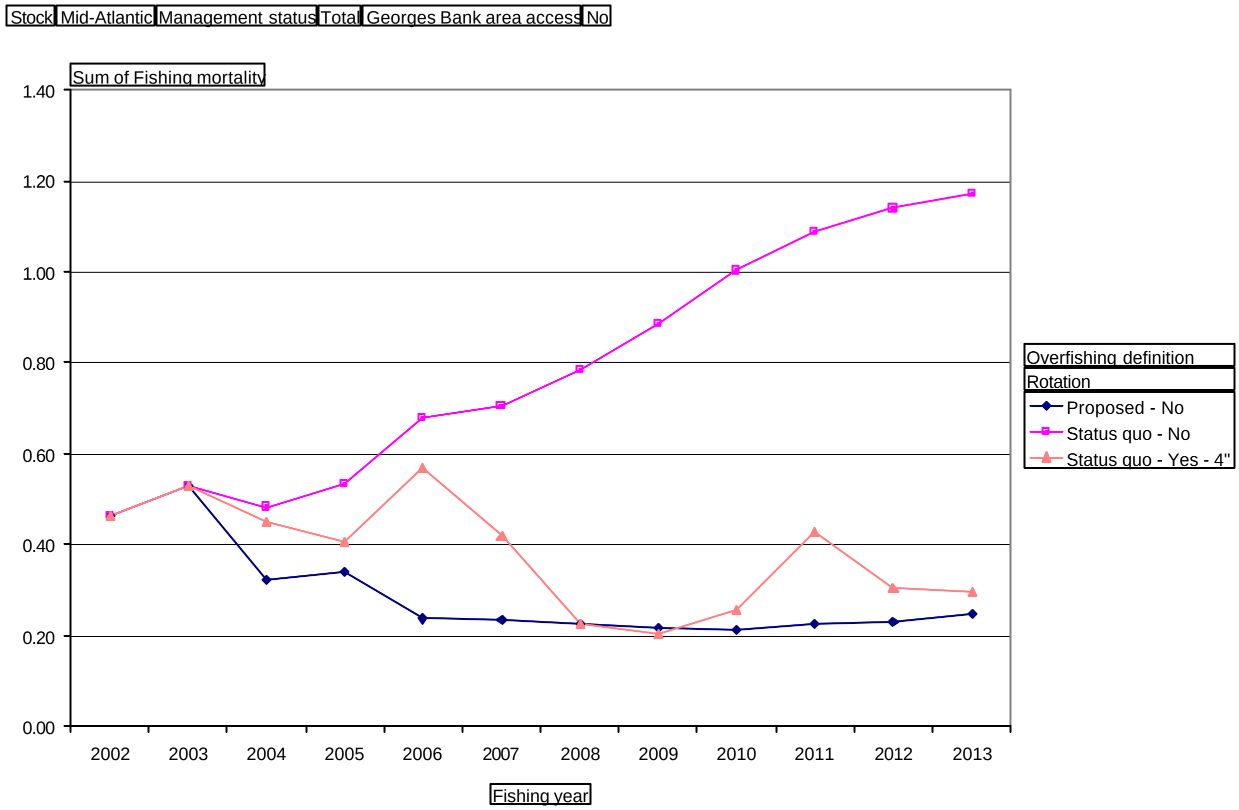

Figure 72. With Georges Bank access: Projected annual fishing mortality rates for the Mid-Atlantic scallop resource.

8.2.2.3.4 Trends and Distribution of Total Area Swept

Area swept is an important element to understanding ancillary impacts, especially those on finfish bycatch and on habitat. The amount of fishing time and area swept is estimated in this section, while the distribution of the fishing time and area swept relative to areas, substrates, and EFH designations is analyzed and discussed in Sections 8.5.4.14.1and 8.5.4.14.2. In addition to analyzing the trends and distributions of historic limited access effort, Section 8.5.7.2.1.1 goes a step further and analyzes the probable distribution of scallop fishing effort under area rotation, by applying the rotation management area swept area estimates to the VMS effort distributions within each rotation management area

Total area swept is calculated from the total projected DAS use and the amount of fishing time per DAS, multiplied by the dredge width. For purposes of analytic comparisons, the projections assume that the total width of a vessel's dredges is 30 feet, even though some vessels use smaller dredges (sometimes to qualify for a higher DAS allocation category) or trawls.

The projection estimates also assume no overlap of any tow during the year and is therefore an overestimate of the total area swept one or more times in the year. An analogy is the amount of highway area needed if each car has its own traffic lane and gets a new, unused traffic lane each day. Nonetheless total area swept is a useful measure as an index of fishing effects assuming that the concentration of fishing effort is fairly constant.

In general, the alternative proposed overfishing definition minimizes bottom contact time and area swept, through the combined effects of lower DAS use and higher LPUE[67]. The use of 4" rings is projected to reduce total area swept when using the status quo overfishing definition as the basis for annual mortality targets. This result occurs because of the combined effects of higher dredge efficiency for large scallops and higher LPUE from the effects of using 4" rings.

With access and mechanical rotation of the Georges Bank closed areas, the final alternative ("Status quo – Yes – 4"; Figure 73) is projected to reduce area swept from 7,493 nm2 in 2003 to 3,901 nm2 in 2004, average 5,076 nm2 in 2005-2007, then increase to around 10,000 nm2 after the first rotation of Georges Bank closed area access. Total area swept of 10,000 nm2 is approximately the area swept when the fleet uses 38,000 DAS continuously.

Without rotation, the area swept by applying the status quo overfishing definition is about the same as with rotation in 2004-2006, but then remains low with a long-term average of 6,332 nm2. The al proposed overfishing definition total area swept is projected to be lower, declining to 2,812 nm2 in 2004, then fluctuating between 2,000 to 3,500 nm2, with a long-term average of 3,098 nm2 without rotation and 3,189 nm2 with rotation. The total area swept is sometimes higher with rotation than without because area rotation is projected to increase productivity by 5 to 15 percent and it takes slightly more fishing to capture the benefits of area rotation while achieving the fishing mortality objectives.

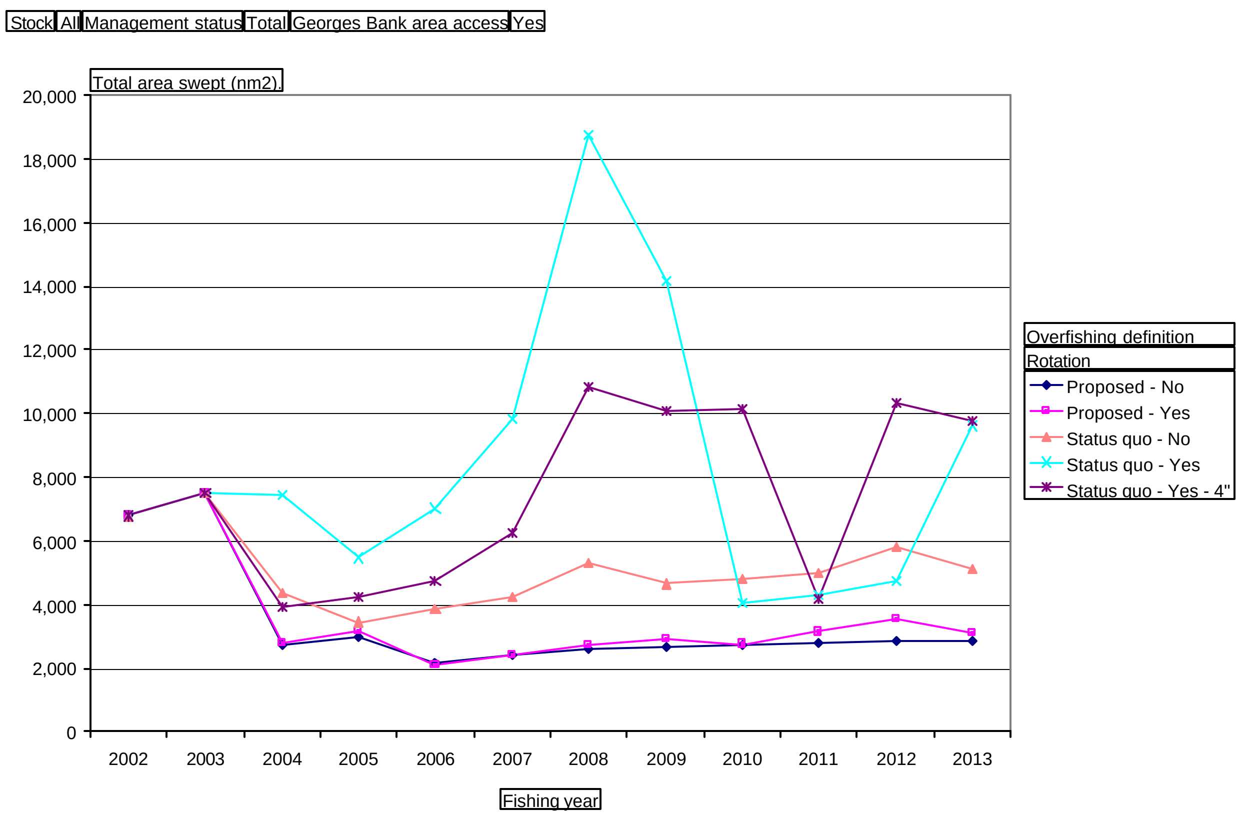

Figure 73. With Georges Bank access: Average projected total annual area swept by scallop fishing.

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67 CPUE, or catch per unit effort, is estimated in the projections as landings per DAS. Dead scallop discards are a small fraction of the total catch and are taken into account by the projection model assumptions.

Without access to the Georges Bank closed areas, the area swept differences between the application of the two alternative overfishing definitions is greater, particularly from the interaction between large area closures and the status quo overfishing definition. For the final alternative ("Status quo – Yes – 4"; Figure 74), area swept is projected to decline to 5,402 nm2 in 2004, the increase to around 12,000 nm2. Without rotation or access ("Status quo – No"), the projected area swept drops to about the same level as with area rotation, the gradually rises to the long-term average, 15,291 nm2. In contrast, the alternative proposed overfishing definition is projected to reduce area swept even without access to the Georges Bank closed areas, declining to 2,687 nm2 in 2004 with a gradual rise to the long-term average, 3,098 nm2.

Figure 74. With no Georges Bank access: Average projected total annual area swept by scallop fishing.

The projection for the final alternative was summarized in greater detail to provide some geographical distribution data. All variables, including catch and biomass, were computed, but the geographical distribution of a variable of particular interest is area swept, because it has bearing on how area rotation and access could affect finfish bycatch and habitat.

In 2004 (Figure 75), 74% of the projected area swept is expected in the Mid-Atlantic region (MA1 to MA9). Over half of the bottom contact time and area swept in the Mid-Atlantic is projected to occur in two rotation management areas, MA7 and MA8, which are located in the NY Bight, north of the Hudson Canyon Area. Part of MA7 overlaps the Hudson Canyon Area, which will continue under controlled access through 2005.

In contrast, effort and total area swept is projected to remain relatively low in the Georges Bank region, in spite of controlled access to the Georges Bank closed areas. Although substantial catches from

Nantucket Lightship Area and Closed Area I are expected, the high daily catch rates combined with the crew shucking capacity will keep the area swept in GB12 and GB09 around only 7 percent of the total.

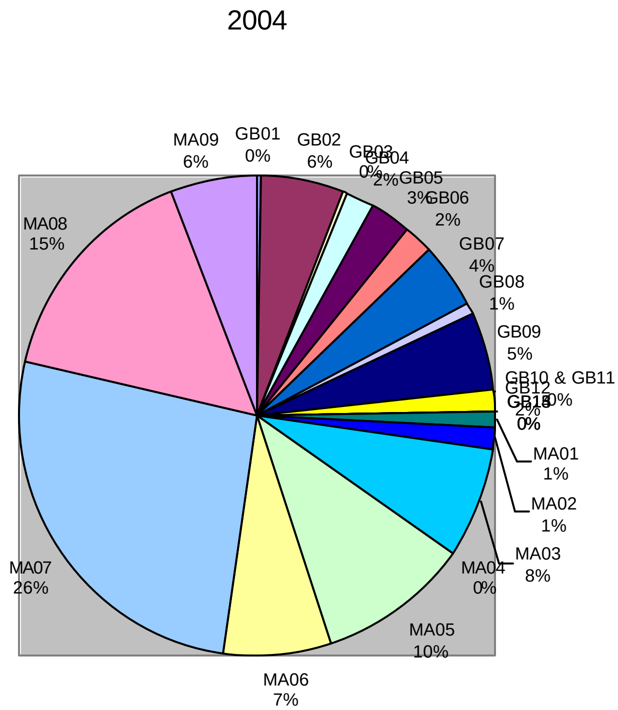
In 2005, the outlook is similar but there is a slight increase in the percent of total fishing time and area swept in the Georges Bank region (Figure 75), increasing from 24 percent in 2004 to 31 percent in 2005. Even with controlled access to Closed Area II (i.e. GB14), the bottom time and area swept is projected to be only 5 percent of the total.

The situation changes markedly in 2006, because Amendment 10 contemplates that the Hudson Canyon Area would no longer be regulated as a controlled access area. Due to high catch rates coupled with open access, MA05 and MA06 which overlap the Hudson Canyon Area is projected to attract fishing effort and contribute to 65 percent of the bottom contact time and area swept (Figure 76). The Closed Area II controlled access area is projected to continue to have a very low bottom contact time and area swept, only 5 percent of the total, despite the substantial catches anticipated.

This projected outlook continues in 2007 (Figure 76), but the bottom contact time and area swept for the MA05 and MA06 areas that overlap the Hudson Canyon Area would decline to 39 percent of the total. If the "Elephant Trunk" area re-opens under controlled access regulation[68], like the Georges Bank closed area access, the area swept is expected to be low and contribute only 2 percent of the total despite relatively large DAS allocations and catches in the re-opened area.

Over the long term, the total area swept for Georges Bank is projected to be a much greater share of the total, reflecting a return to average recruitment conditions. Since 1997, recruitment has been well above average in the Mid-Atlantic region and the current DAS use and area swept distribution reflect that temporary imbalance in resource productivity. Under average conditions, the projections indicate that 53 percent of the bottom contact time and area swept would occur in the Georges Bank region (Figure 77), but that 49 percent would occur in the open areas of Georges Bank, assuming that the Georges Bank closed areas continue under a mechanical rotation of controlled access.

[68] The area would not open in three years by default, but could re-open in 2007 (or earlier or later) by framework action, depending on resource conditions and anticipated future rotation management.



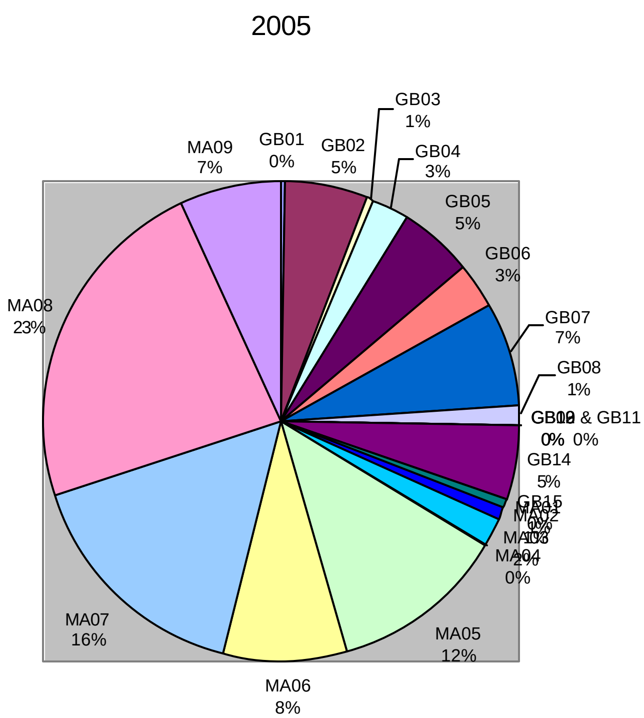
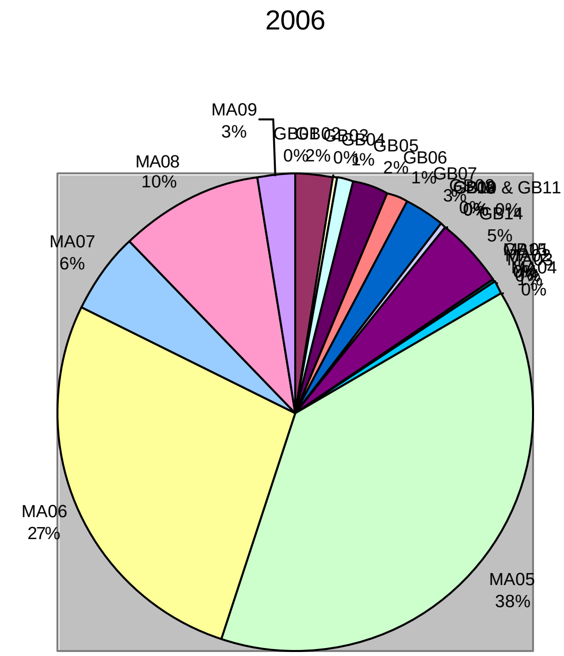


Figure 75. With Georges Bank access: Average distribution of area swept by rotation management area, for 2004 – 2005. See Map 7 for key



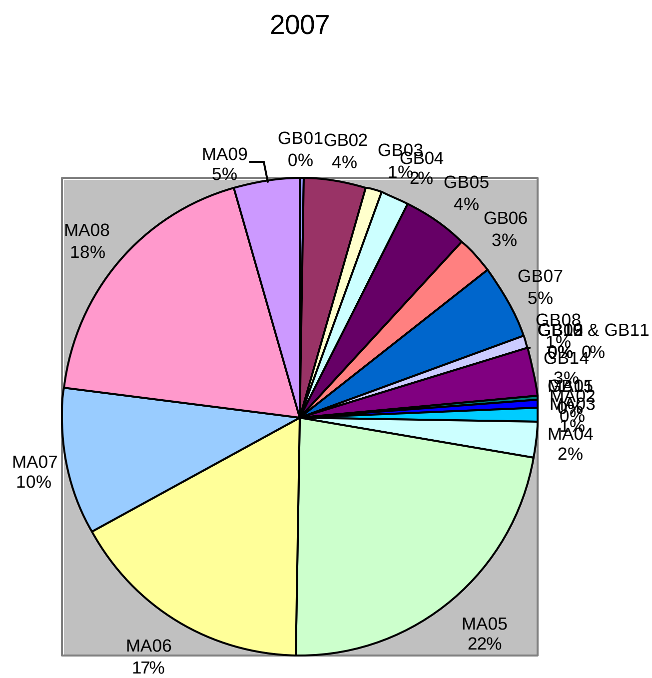


Figure 76. With Georges Bank access: Average distribution of area swept by rotation management area, for 2006 – 2007. See Map 7 for key.

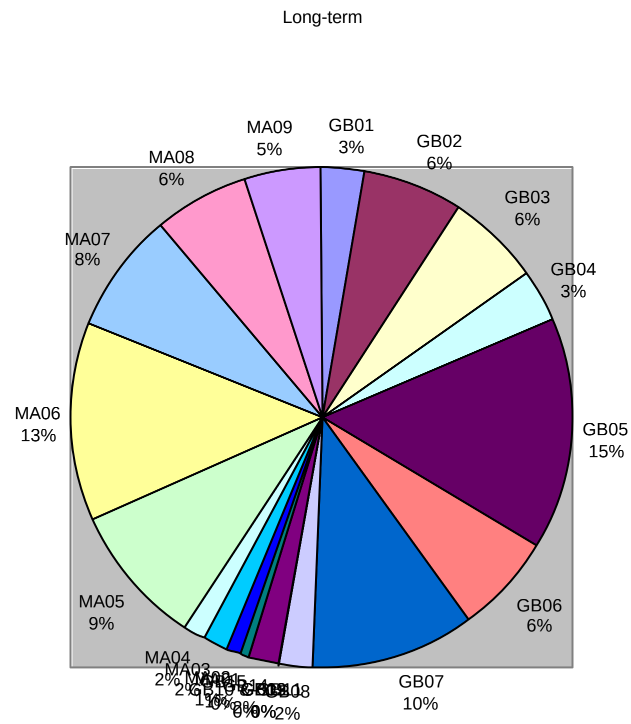


Figure 77. With Georges Bank access: Average distribution of area swept by rotation management area, summed for long-term. See Map 7 for key.

8.2.2.3.5 Trends in Total biomass

The survey total biomass index is used to compare with appropriate biological reference points to determine whether the scallop stock is overfished, i.e. below ½B_{MSY}, or near the target. This biological reference point (B_{max}) is derived from the expected biomass index if the stock is continuously fished at F_{max}, or the mortality rate that is calculated to produce maximum yield-per-recruit. The current estimate of B_{max} is 5.60 kg/tow, or 5,600 gtow.

With the status quo overfishing definition, the total biomass is projected to gradually increase to 7.1 kg/tow in 2004 to 7.5 kg/tow by 2012 (Figure 78), near the long-term average of 7.7 kg/tow. Differences between the projected biomass on a region-wide basis are insignificant with regard to area rotation and 4” rings. Area rotation with the status quo overfishing definition, however, is projected to have slightly lower total biomass than without rotation, due to the higher fishing mortality rates applied in open areas when a greater share of the resource area is closed. Requiring 4” rings helps to make up the difference.

Projections for the alternative proposed overfishing definition, on the other hand, show a gradual and continuing increase in total biomass from 7.6 kg/tow in 2004 to nearly 9.0 kg/tow by 2012, before leveling off around the 9.5 – 9.7 kg/tow long-term average. With the proposed overfishing definition, the biomass is projected to be higher with area rotation than without, unlike the situation with the status quo overfishing definition.

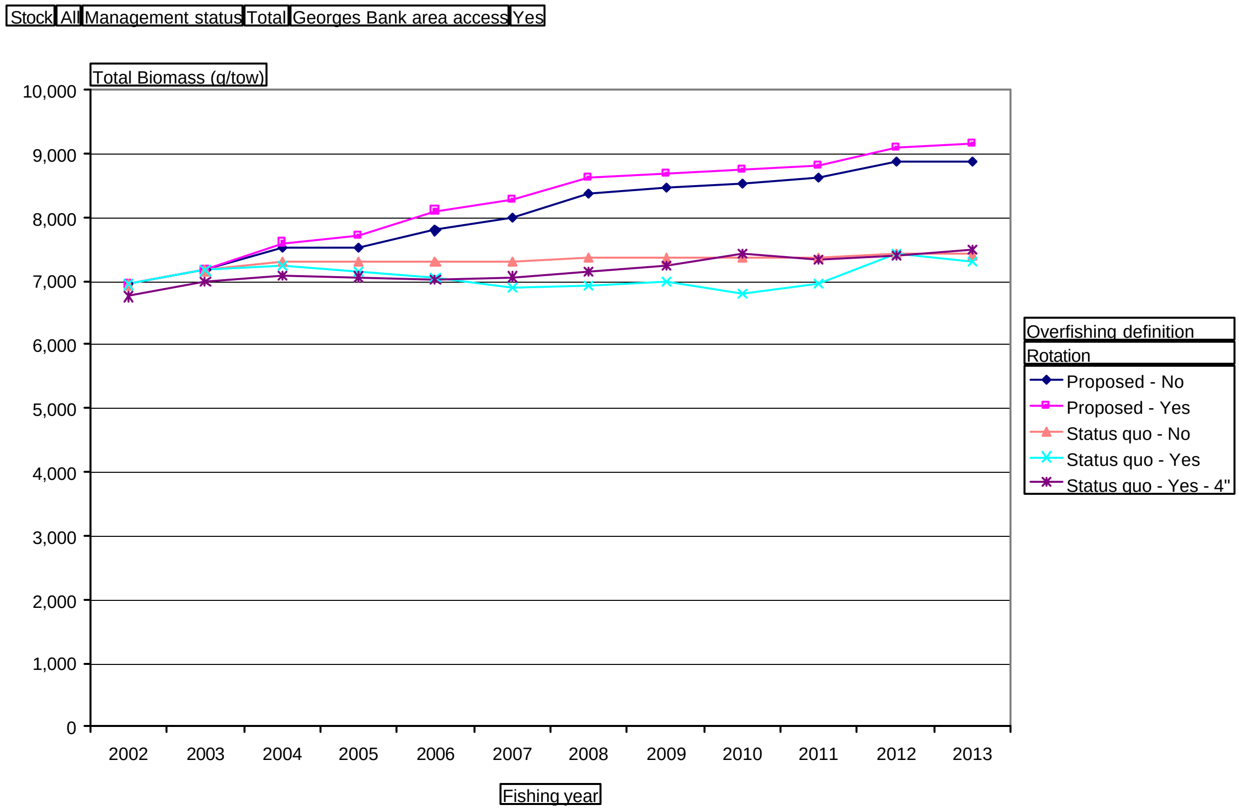


Figure 78. With Georges Bank access: Annual projected trends in total biomass of scallops in the Mid-Atlantic and Georges Bank regions.

Over the long-term, the effects of the current scallop distributions and recent management practices level out and the biomass is a reflection of the results of area rotation, gear requirements, and the application of the target fishing mortality rates for the two overfishing definitions. The table below shows the projected long-term average biomass for each management scenario and management area. The effect of area access is observable, where biomass without access is projected to increase to 43 kg/tow, but stabilize around 24 kg/tow with access. In the Georges Bank open areas and in the Mid-Atlantic region, the differences arise mainly from the application of the target fishing mortality rate for each overfishing definition. The alternative proposed overfishing definition is projected to give a total scallop biomass of 6.6 to 7.0 kg/tow in Georges Bank open areas and 4.9 kg/tow in the Mid-Atlantic region. In contrast, the final alternative ("Status quo – Yes – 4") is projected to produce an average long-term biomass of 3.5 – 3.7 kg/tow in the Georges Bank open areas and 3.2 – 3.3 kg/tow in the Mid-Atlantic region. The status quo management with no rotation and 3 ½ rings is projected to produce an average scallop biomass of 2.6 kg/tow in the Georges Bank open areas and 3.2 – 3.3 kg/tow in the Mid-Atlantic region, with access to the Georges Bank areas. Without access, the average scallop biomass is projected to be only 0.9 kg/tow in the Georges Bank open areas and 1.1 kg/tow in the Mid-Atlantic region.

Table 164. Comparison of long-term projected total scallop biomass by management area for various scallop management alternatives. The final alternative is the status quo overfishing definition, with rotation and 4” rings (“Yes – 4”).

Total biomass (kg/tow).

		Stock	Mid-Atlantic	Management status: Georges Bank			All
Georges Bank area access	Overfishing definition	Rotation	Total	Georges Bank area access	Total	Open areas	Total
No	Proposed	No	4.9	43.4	23.7	6.8	13.6
	Status quo	No	0.9	43.4	20.7	1.1	10.1
		Yes - 4"	3.2	43.1	21.9	3.7	11.9
Yes	Proposed	No	4.9	24.4	14.8	6.6	9.5
		Yes	5.0	24.4	15.1	7.0	9.7
	Status quo	No	2.6	24.4	13.3	3.8	7.6
		Yes	3.4	24.4	13.3	3.7	8.0
		Yes - 4"	3.3	23.9	12.9	3.5	7.7

The trends in biomass for the Georges Bank region are projected to show a similar pattern, but at a higher level due to the existence of large closed areas that were not open to fishing during 2000 by Framework Adjustment 13. Total biomass is projected to rise from 10.6 to 11.4 kg/tow in 2004 to 11.6 to 13.7 kg/tow by 2012 (Figure 79). Generally, the Georges Bank total biomass index is projected to be lower when using the status quo overfishing definition than when using the alternative proposed overfishing definition especially after 2008, but all are expected to be well above the biomass that would achieve MSY from scallops in the Georges Bank region.

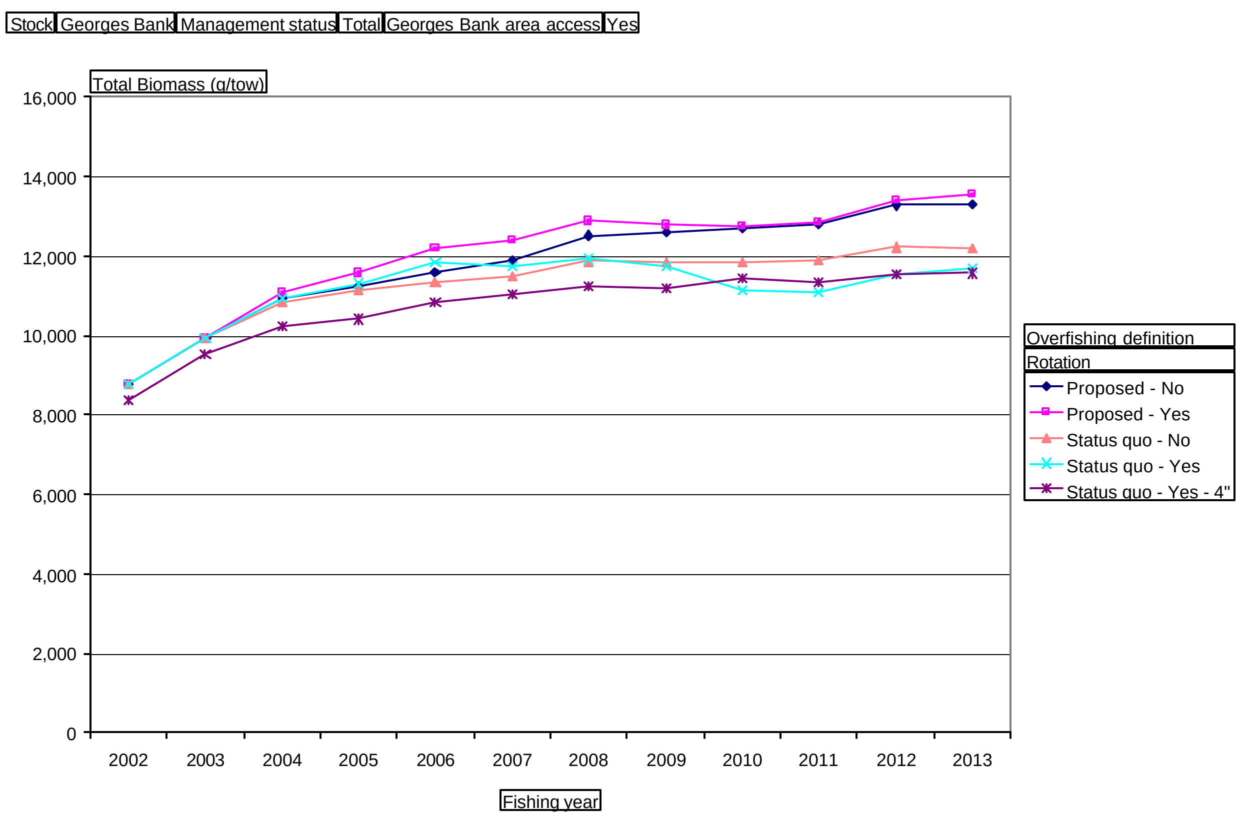


Figure 79. With Georges Bank access: Annual projected trends in total biomass of scallops in the Georges Bank region.

With access to the Georges Bank closed areas, most of the differences in total biomass for scallops in the Georges Bank region occur in the open fishing areas (Figure 80). Total biomass is expected to rise from 2.1 kg/tow in the open areas of the Georges Bank region during 2003 to 4.0 to 5.6 kg/tow by 2006. After that the projected biomass levels off around 4.0 to 4.5 kg/tow when using the status quo overfishing definition. The status quo overfishing definition scenario projected biomass declines with area rotation and 3½" rings in 2010 to around 3.0 kg/tow, presumably due to the higher fishing mortality associated with the open areas under the status quo overfishing definition. Requiring 4" rings (the final alternative) seems to compensate for this effect. Using the alternative proposed overfishing definition, the open area total biomass for the Georges Bank region is projected to continue a gradual increase to 6.4 to 6.8 kg/tow by 2013.

Figure 80. With Georges Bank access: Annual projected trends in total biomass of scallops in the open areas of the Georges Bank region.

Within the Georges Bank closed areas, assuming access to the areas fished in 2000, beginning in 2003, the total biomass is expected to remain relatively stable at about 20.0 kg/tow throughout the time series (Figure 81). This occurs because the fishing mortality targets and TACs for mechanical rotation of the Georges Bank controlled access areas operates independent of the application of the overfishing definition or area rotation elsewhere. Total biomass is projected to be slightly lower if 4" rings are required.

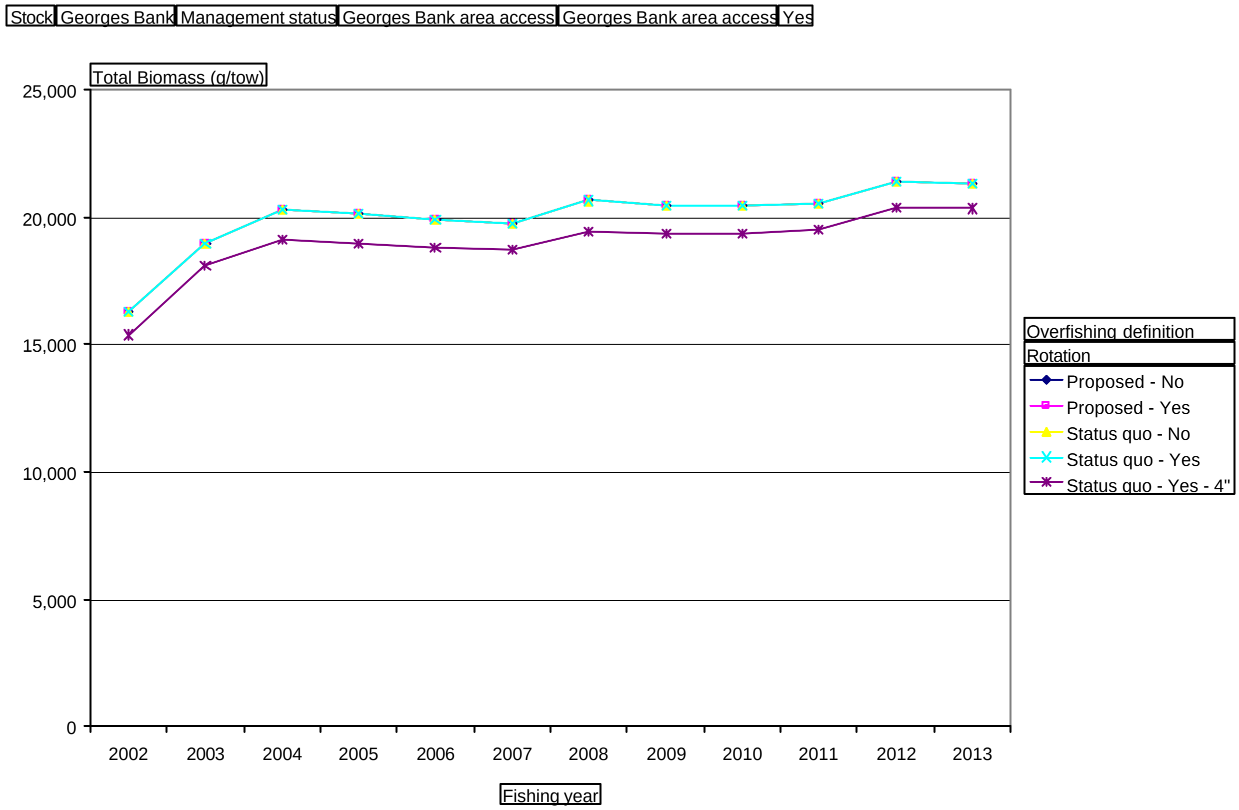


Figure 81. With Georges Bank access: Annual projected trends in total biomass of scallops in the Georges Bank groundfish closed areas (including areas under controlled access regulations).

Biomass trends in the Mid-Atlantic region follow the projected pattern in open areas of Georges Bank, except that with the status quo overfishing definition, the projected biomass declines from current levels. With rotation and 3 ½ " rings ("Status quo – Yes";), the Mid-Atlantic region biomass is projected to decline from 4.8 kg/tow in 2003 to 2.6 kg/tow by 2008.

The biomass decline is less steep when 4" rings are required ("Status quo – Yes – 4"), consistent with the final alternative. Total biomass is projected to decline to 3.6 kg/tow by 2006 and then gradually increase to 4.0 kg/tow by 2013. The long-term projected biomass average is 3.6 kg/tow. Beginning in 2008, the Mid-Atlantic region biomass level is expected to be higher under the final alternative using 4" rings than without area rotation. Area rotation with 3.5" rings is projected to result in the steepest decline in Mid-Atlantic scallop biomass.

With the alternative proposed overfishing definition, total biomass is projected to decline to 4.4 kg/tow by 2005, then gradually increase to 5.1 to 5.3 kg/tow by 2013. The long-term projected biomass is 4.7 kg/tow with the alternative proposed overfishing definition. Area rotation is expected to increase the total biomass level compared to that expected without area rotation.

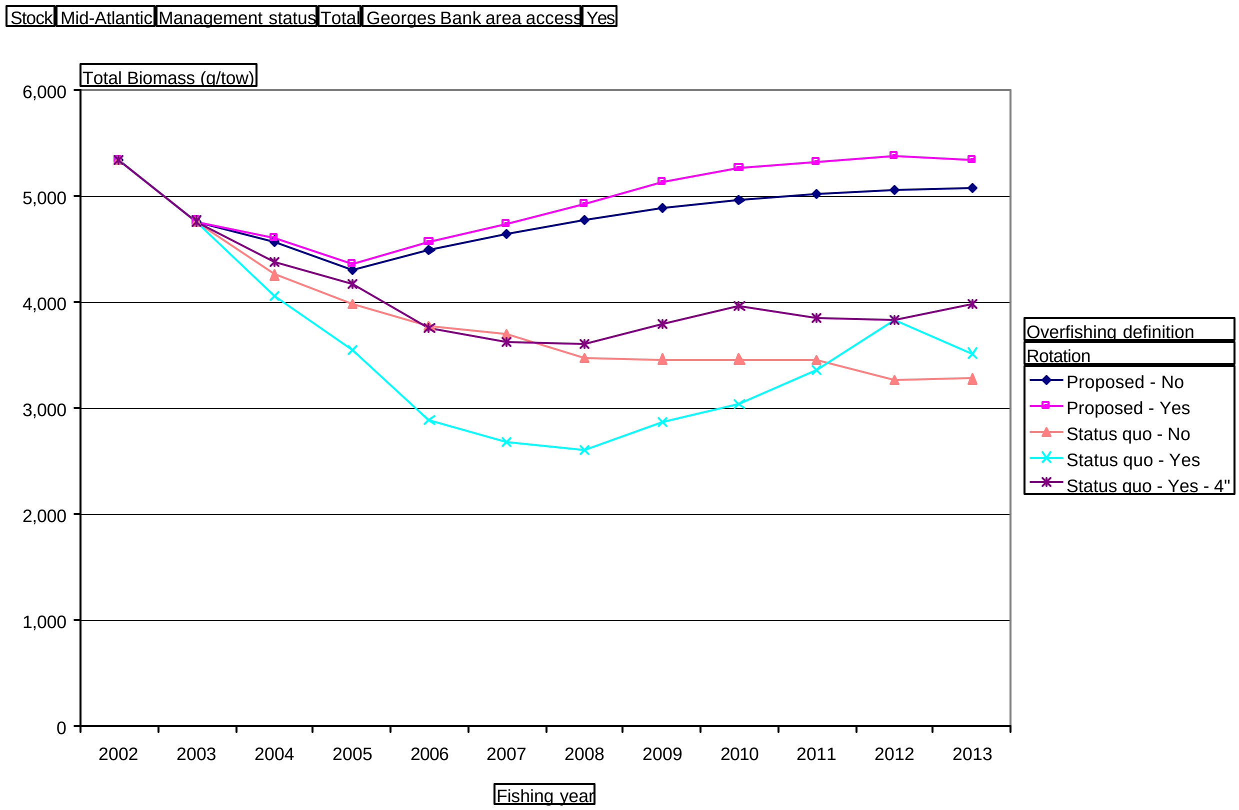


Figure 82. With Georges Bank access: Annual projected trends in total biomass of scallops in the Mid-Atlantic region.

Without access to the Georges Bank closed areas, the total biomass is expected to climb much higher with the alternative proposed overfishing definition, because the average fishing mortality across all areas are lower. In addition to the near-zero fishing mortality in closed areas, the proposed overfishing definition fishing mortality target is 0.2 in open fishing area, maximizing yield from the scallops available to the fishery. In other words, without access, the trend in biomass in the Georges Bank closed area is exactly the same, and the higher fishing mortality in open fishing areas under the status quo overfishing definition (i.e. applying its fishing mortality target to the entire resource instead of only areas open to fishing).

Although large scallop resource areas would remain closed without access, total scallop biomass for the status quo overfishing definition is projected to rise from 7.0 kg/tow in 2003 to 8.3 kg/tow in 2013 with 3.5” rings and no area rotation (Figure 83). With 4” rings and area rotation [final alternative (“Status quo – Yes – 4”], total scallop biomass is expected to rise faster, particularly after 2006, rising to 10.3 kg/tow by 2013. With the alternative proposed overfishing definition and 3½“ rings, total stock biomass is expected to rise more and more quickly, reaching 11.8 kg/tow by 2013.

Without access, all projections indicate that stock biomass will remain well above the resource-wide B_{max} target, irregardless of which overfishing definition is in use or whether area rotation is implemented.

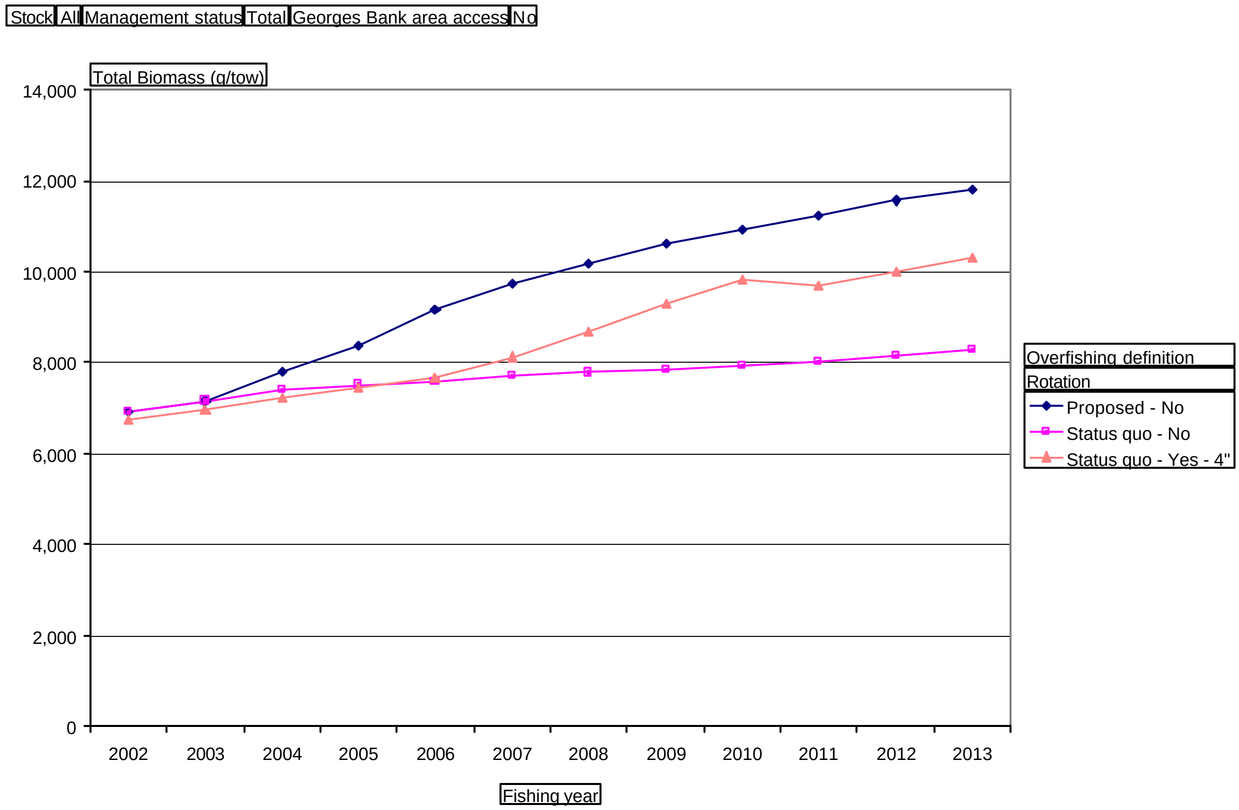


Figure 83. With no Georges Bank access: Annual projected trends in total biomass of scallops in the Mid-Atlantic and Georges Bank regions.

Stock biomass trends in open fishing areas, however, reveal greater disparities between the alternatives. For the final alternative ("Status quo – Yes – 4"; Figure 84), scallop biomass in the open areas of the Georges Bank region is projected to nearly double over the current value. Initially, biomass is projected to increase from 2.1 kg/tow in 2003 to 2.2-2.3 kg/tow in 2004-2005, then begin rising to 4.5 kg/tow in 2010 before falling off to 3.6-4.0 kg/tow, with a long-term average biomass of 3.7 kg/tow.

Applying the status quo overfishing definition with 3 ½ " rings but without area rotation ("Status quo – No") is expected to cause declines in open area Georges Bank biomass. Initially, biomass is projected to increase to 3.0 kg/tow in 2006 and then begin declining to 1.3 kg/tow by 2013. The long-term average biomass for this alternative is 1.1 kg/tow.

Applying the alternative proposed overfishing definition and area rotation produces radically different results, however, even when 3 ½ " rings are used ("Proposed – No"). Biomass in the Georges Bank open areas is projected to rise steeply to 6.0 kg/tow in 2007, before leveling off. A slight rise in biomass is projected in 2012 and 2013. The long-term average biomass for the Georges Bank areas is 6.8 kg/tow.

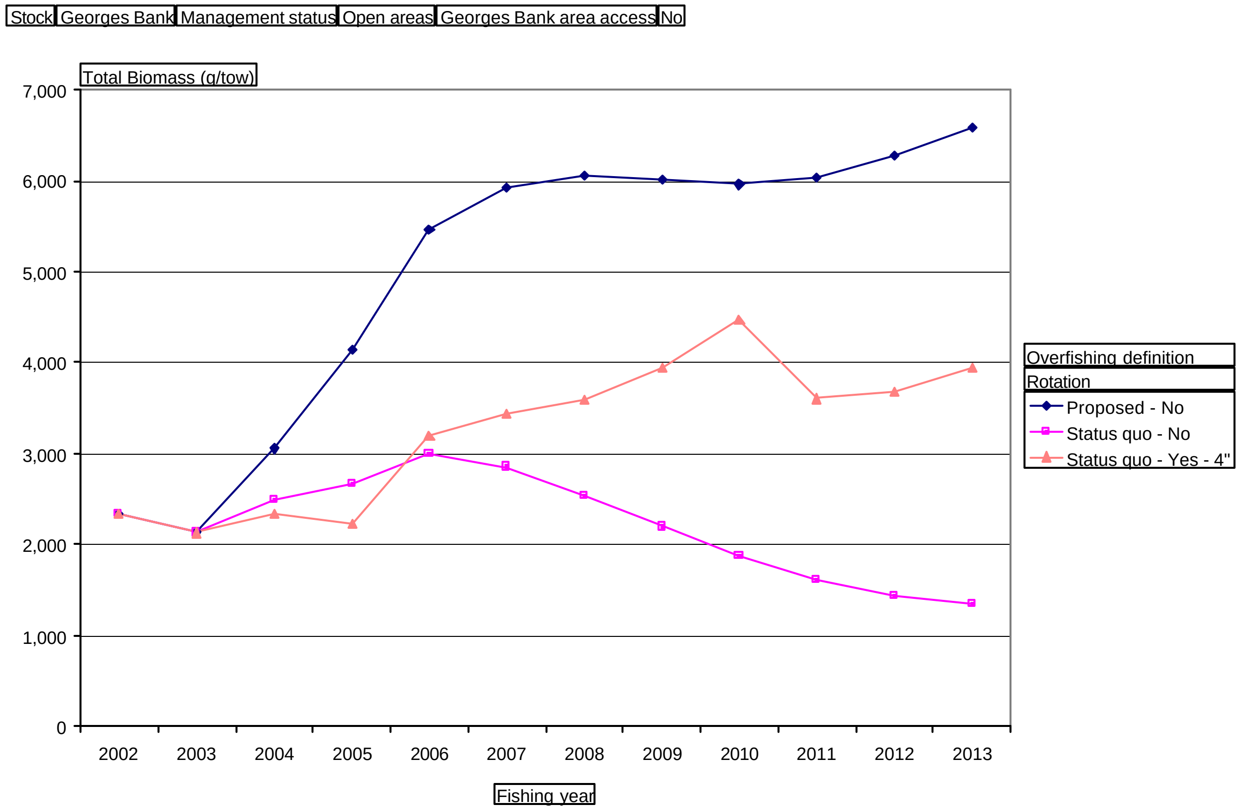


Figure 84. With no Georges Bank access: Annual projected trends in total biomass of scallops in the open areas of the Georges Bank region.

The biomass trends in the Mid-Atlantic region without access are similar to those above for the open areas of the Georges Bank region, but at a lower level compared to current conditions partly due to the assumption that recruitment will return to the time-series average[69] and an assumption based on empirical data that the fleet favors fishing in the Mid-Atlantic due to lower fishing costs and proximity to the major Mid-Atlantic ports.

For the final alternative ("Status quo – Yes – 4"; Figure 85), scallop biomass in the Mid-Atlantic is projected to decline from 4.8 kg/tow in 2003 to 3.0 kg/tow by 2006, before increasing again to 3.9 kg/tow in 2010. The long-term average is 3.2 kg/tow.

Total biomass is projected to decline much more under the status quo overfishing definition with 3½" rings, but without rotation ("Status quo – No"). Total biomass is projected to steadily decline to 1.0 kg/tow by 2013, near the long-term average of 0.9 kg/tow. The target fishing mortality rate for the alternative proposed overfishing definition, on the other hand, keeps biomass at much higher levels, declining only to 4.3 kg/tow in 2005 before increasing to 5.2 kg/tow in 2013, slightly above the long-term average of 4.9 kg/tow.

[69] Although the recruitment was assumed to return to average conditions, the projections were run over a wide range of recruitment ranges that were represented by the historic distribution of annual recruitment levels. The projection results are presented as the average of these stochastic simulations.

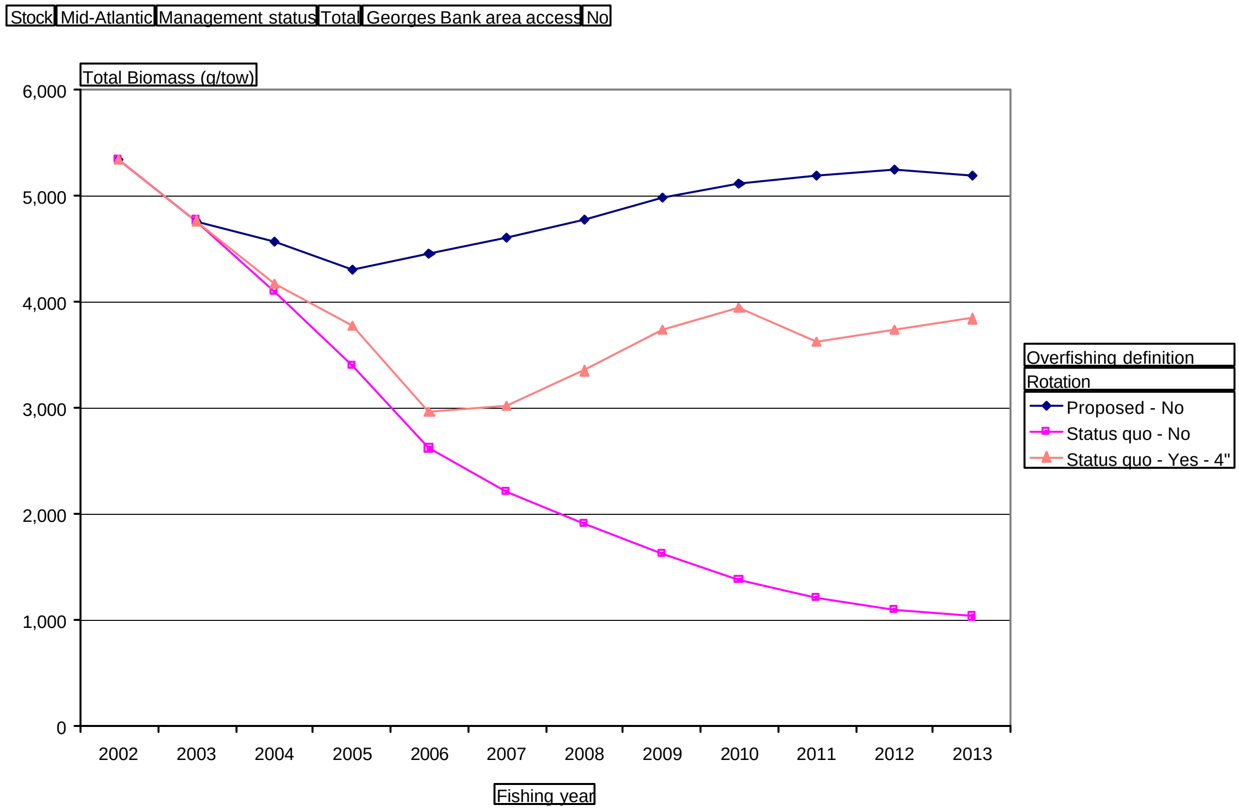


Figure 85. With no Georges Bank access: Annual projected trends in total biomass of scallops in the Mid-Atlantic region.

8.2.2.3.6 Trends in Landings and Daily Catches (LPUE)

Projected landings are more affected by whether or not there is controlled access for the Georges Bank closed areas than by which overfishing definition is in place. Long-term average annual landings are shown in Table 165 for comparison across overfishing definition alternatives, scallop management alternatives, and management areas. Without access, however, area rotation and 4" rings make a substantial difference (32.7 million pounds vs. 19.0 million pounds with 3 ½ " rings and no rotation). On the other hand, without access, application of the aternative proposed overfishing definition alone actually surpasses the landings with rotation and 4" rings (35.0 million pounds vs. 32.7 million pounds). Without access, about 2/3rd of the landings (20.7 out of 32.7 million pounds) are projected to originate from the Mid-Atlantic region.

With access, long-term average annual landings increase to 43.2 to 48.6 million pounds, with the landings for the alternative proposed overfishing definition exceeding those for the status quo overfishing definition, by about 10 percent. With access, only 40 percent of the long-term average landings are projected to originate from the Mid-Atlantic region and 60% from the Georges Bank region.

Table 165. Comparison of long-term projected total scallop landings [mt (top) and million lbs. (bottom)] by management area for various scallop management alternatives. The final alternative is the status quo overfishing definition, with rotation and 4" rings ("Yes – 4").

Catch (mt)

			Stock	Management status			
			Mid-Atlantic	Georges Bank			All
Georges Bank area access	Overfishing definition	Rotation	Total	Georges Bank area access	Total	Open areas	Total
No	Proposed	No	9,618	0	6,479	6,479	16,097
	Status quo	No	5,413	0	3,205	3,205	8,618
		Yes - 4"	9,370	0	5,472	5,472	14,842
Yes	Proposed	No	9,421	6,183	12,398	6,215	21,819
		Yes	9,519	6,183	12,522	6,338	22,042
	Status quo	No	8,091	6,183	11,501	5,318	19,593
		Yes	8,420	6,183	11,893	5,710	20,314
		Yes - 4"	8,827	6,183	12,076	5,893	20,903

Catch (million lbs.)

			Stock	Management status			
			Mid-Atlantic	Georges Bank			All
Georges Bank area access	Overfishing definition	Rotation	Total	Georges Bank area access	Total	Open areas	Total
No	Proposed	No	21.2	0.0	14.3	14.3	35.5
	Status quo	No	11.9	0.0	7.1	7.1	19.0
		Yes - 4"	20.7	0.0	12.1	12.1	32.7
Yes	Proposed	No	20.8	13.6	27.3	13.7	48.1
		Yes	21.0	13.6	27.6	14.0	48.6
	Status quo	No	17.8	13.6	25.4	11.7	43.2
		Yes	18.6	13.6	26.2	12.6	44.8
		Yes - 4"	19.5	13.6	26.6	13.0	46.1

Under the final alternative ("Status quo – Yes – 4", with access to the Georges Bank closed areas, projected landings are expected average about 20,000 mt (44.1 million pounds; Figure 86). U10[70] scallops are projected to increase to nearly 30 percent of the total and with 10-20 count scallops will comprise nearly 80 percent of the total. In 2004 and 2005, the majority of the projected scallop landings will be 10-20 count, but by 2006, the size composition of landings will be very close to the long-term conditions.

From only a biological yield point of view, landings of 20-30 and smaller scallops are undesirable, because the scallops are caught before reaching their optimum yield potential. Maximum yield potential occurs with scallop landings in the 10-20 category, but very little yield is lost due to natural mortality by landing U10 scallops (U5 or larger, being a different story).

[70] Scallop landings are classified or graded according to average size in approximately 40 lb. bags. The count is an average number of scallop meats per pound and are inversely related to size. Scallop yield for a given size shell also varies seasonally, but this could not be taken into account by the projection model.

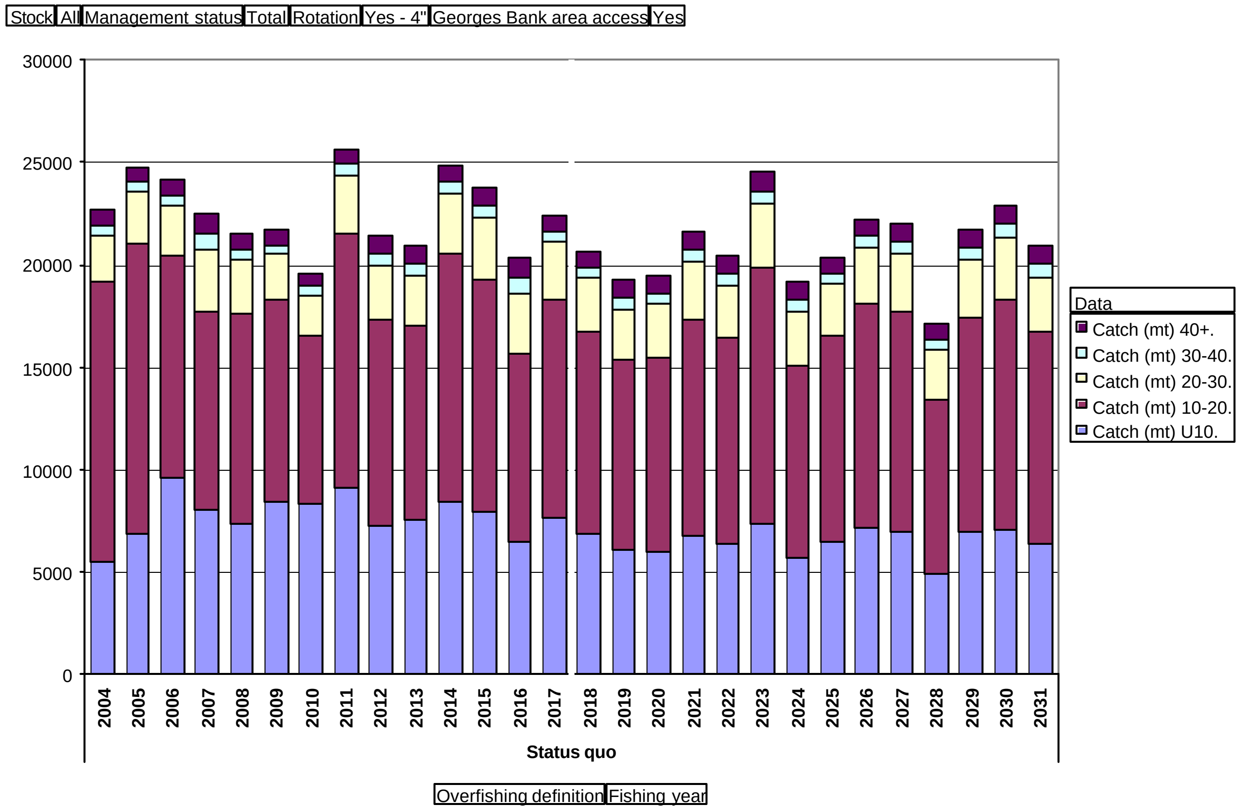


Figure 86. Projected landings (mt) by meat count for the final alternative ("Status quo – Yes – 4") with access to the Georges Bank closed areas. 20,000 mt is equivalent to 44.1 million lbs.

Without access to the Georges Bank closed areas, the projected landings for the final alternative are projected to be considerably more uneven. This choppy pattern comes from the controlled access management of the Hudson Canyon Area and from the application of area rotation in open fishing areas. The latter may be smoothed out by subsequent Council actions under future framework adjustments.

Total landings during 2004 – 2006 would be held up around 17,000 to 19,000 mt by the scallop biomass in the Hudson Canyon Area, followed by a drop to 11,000 to 13,000 mt from 2007 – 2010 (Figure 87). After that the projected landings gradually rise to 14,000 to 16,000 mt in the long-term, even under the status quo overfishing definition. Some of the downturn in landings from open fishing areas without access in 2007 – 2010 and then the gradual increase in landings is an outcome of using 4" rings in open fishing areas where scallops are presently smaller than found in the controlled access areas.

Without access, about 25% of the scallop landings are projected to be classified as U10 and a greater share of the catch will be comprised of 10-20 and 20-30 scallops than with access.

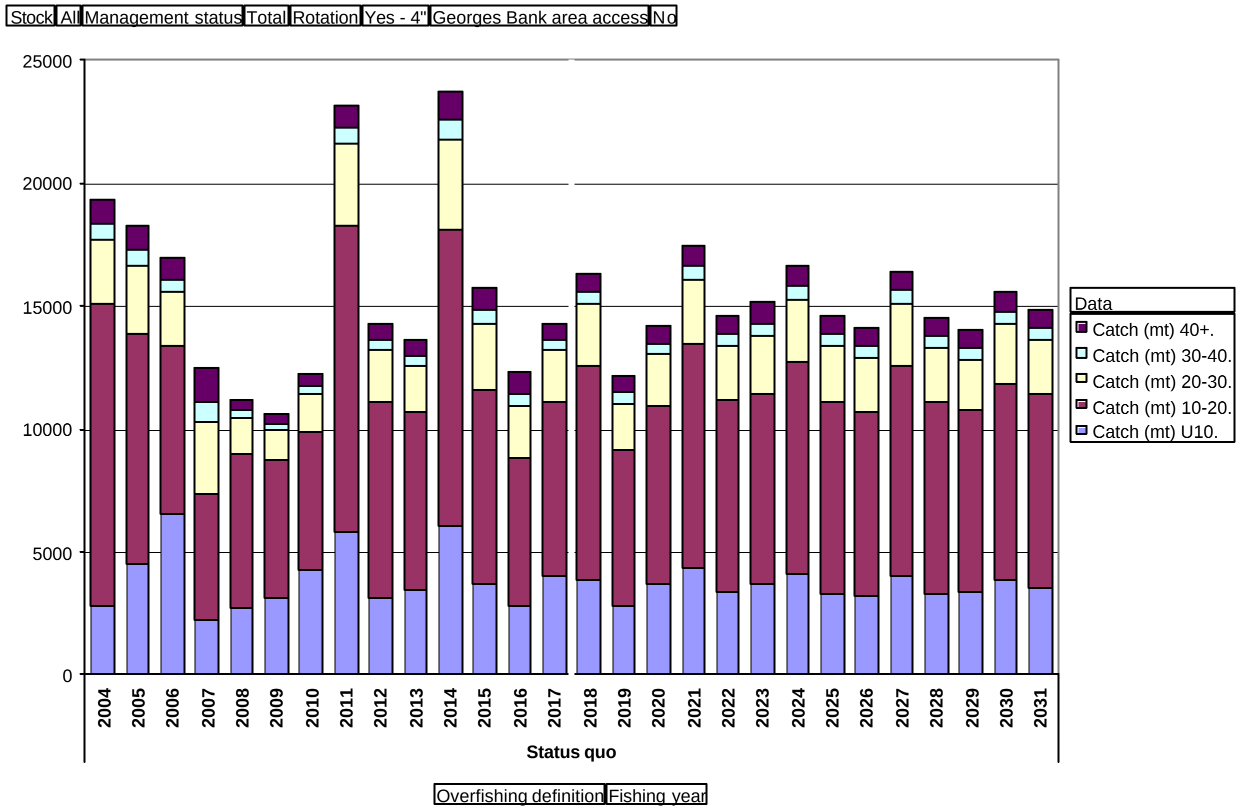


Figure 87. Projected landings (mt) by meat count for the final alternative ("Status quo – Yes – 4") without access to the Georges Bank closed areas. 20,000 mt is equivalent to 44.1 million lbs.

Projected scallop landings from Georges Bank controlled access areas are dominated by U10 and 10-20 scallops. Nearly half of the projected landings from the Nantucket Lightship Area and Closed Area I (2004, 2008, 2012, etc.) are expected to be U10 scallops (Figure 88). According to the final projections, landings from the Nantucket Lightship Area and Closed Area I with a 0.4 fishing mortality target would produce about 5,900 mt, declining to about 3,600 mt in 2012. This decline in landings is desirable, because nearly all of the scallops are U10 and 10-20, larger than that which produces maximum yield-per-recruit.

Applying a fishing mortality target of 0.2 in Closed Area II (2005-2007, 2009-2011, etc.), projected landings would initially be about 9,500 mt (20.9 million pounds), and gradually decline to 6,000 to 7,000 mt per year. About 30% of the total landings from the Georges Bank controlled access areas is projected to be U10, increasing to 45% over the long-term. With U10's, scallops of 10-20 count will make up about 90-95% of the landings through the projected time series.

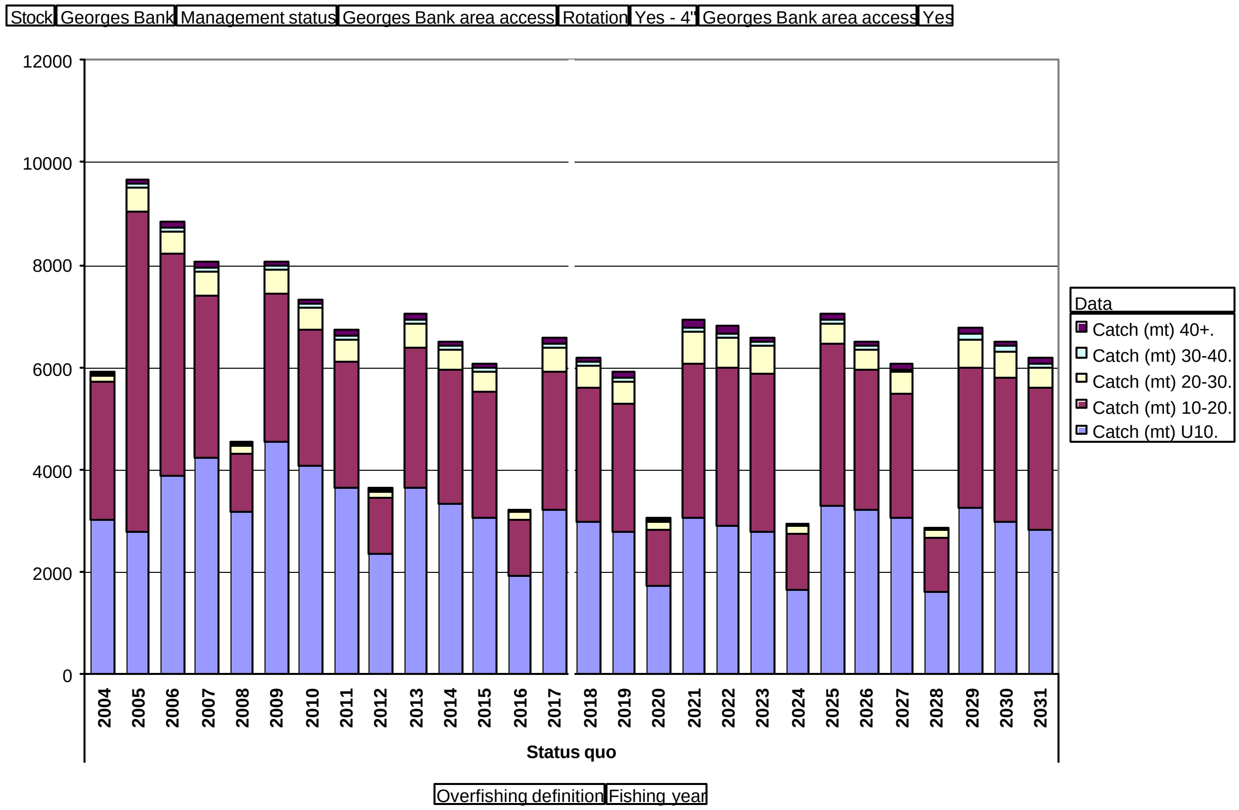


Figure 88. Projected landings (mt) from the Georges Bank closed area access program by meat count. 20,000 mt is equivalent to 44.1 million lbs.

With access, area rotation, and 3 ½ " rings, the projected landings under both overfishing definition alternatives are nearly identical, averaging about 19,000 and 21,000 mt for the status quo and alternative proposed overfishing definitions, respectively (Figure 89).

The size composition of the projected landings are, however, different. With the status quo overfishing definition, about 30% of the projected landings are U10s, 50 percent are 10-20, and 12 percent are 20-30. In contrast, the projected landings for the alternative proposed overfishing definition are 40% U10s, 45% 10-20, and 10% 20-30, favoring landings of larger scallops.

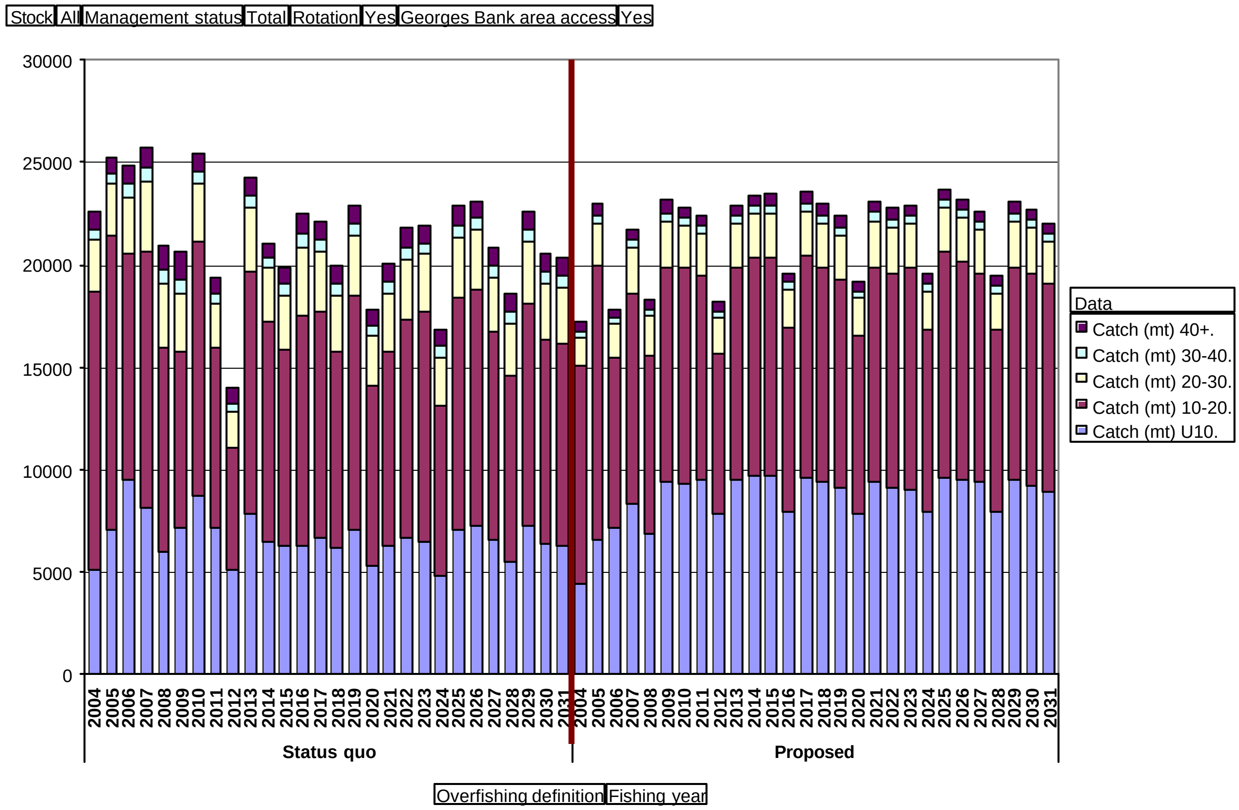


Figure 89. Projected landings (mt) by meat count for the status quo and alternative proposed overfishing definition, with rotation and access, and 3 ½ " rings. 20,000 mt is equivalent to 44.1 million lbs.

The difference in size composition and DAS use between the overfishing definition alternatives is borne out in the catch per DAS (LPUE) estimates (Figure 90). For the final alternative ("Status quo – Yes – 4"), catch rates are projected to increase from 1,721 lbs./day in 2003 to 2,157 lbs./day in 2004 with access. The average catch rate is projected to remain above 2,100 lbs./day through 2006 and then decline to 1,260 lbs./day by 2008.

With 3 ½ " rings and the status quo overfishing definition, catch rates are initially lower around 1,759 to 2,065 lbs./day in 2004 – 2006, falling to as low as 891 lbs./day in 2008. With access, the daily catches are actually higher without area rotation and using 3 ½ " rings. Daily catches are projected to increase to 2,150 to 2,359 lbs./day in 2004-2006 then decline only to 1,725 to 2,120 lbs./day.

In contrast, the daily catches with the alternative proposed overfishing definition are much higher, resulting from the catches derived from higher biomass, larger scallop size, and fewer DAS. Projected daily catches rise from 1,721 lbs./day in 2003 to 2,300 to 2,500 lbs./day throughout the projected time series.

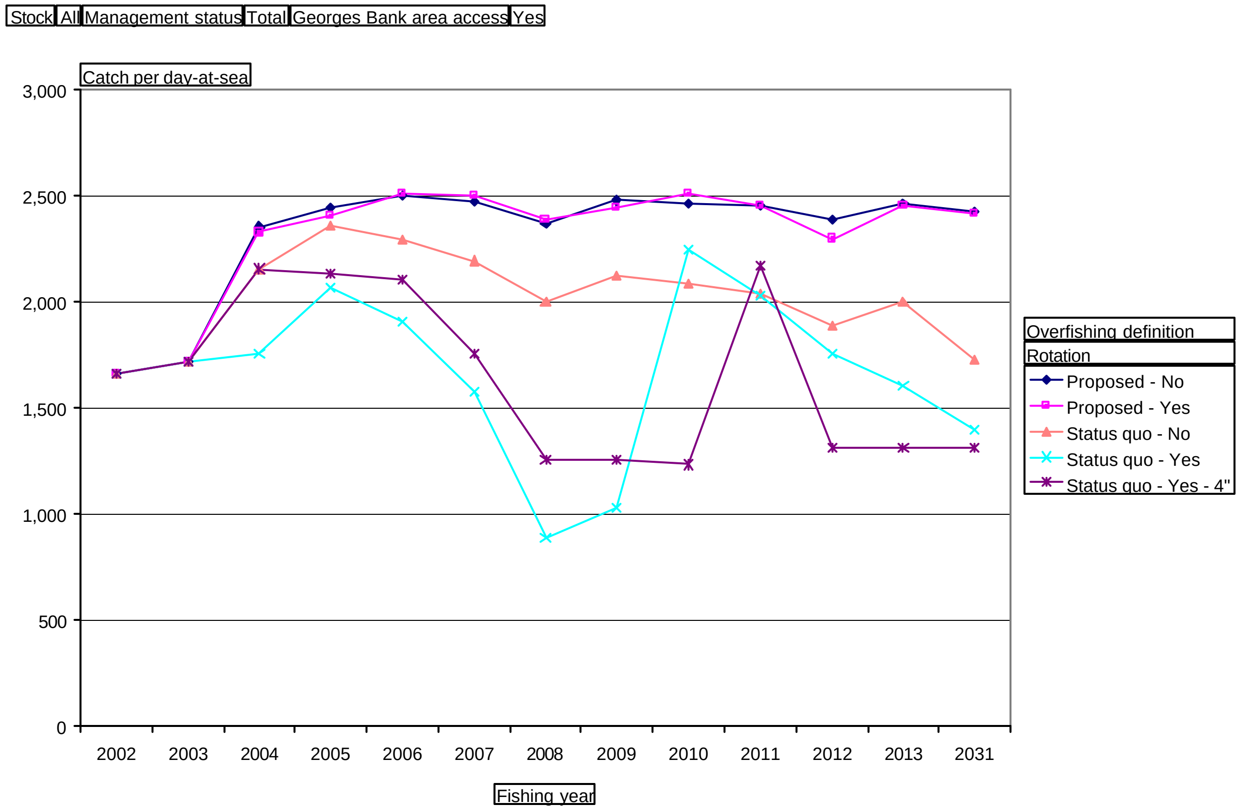


Figure 90. Trends in average catch rates (lbs./DAS) for limited access scallop vessels assuming access to the Georges Bank closed areas.

The projected landings for the two overfishing definition alternatives are much different from one another without access or area rotation, primarily due to the application of a resource-wide fishing mortality target by the status quo overfishing definition.

With the status quo overfishing definition, projected landings average around 19,000 mt (41.9 million pounds) per year from 2004-2006 (Figure 91). After that the projections indicate that average annual landings would decline precipitously to 8,600 mt (19.0 million pounds). Landings of U10 and 10-20 count scallops would decline from 75% of the total to only 30%.

In contrast, projected landings for the alternative proposed overfishing definition with no access or rotation would start around 13,000 mt (28.7 million pounds) in 2004 and with the exception of 2006, gradually increase to about 16,000 mt (35.3 million pounds). Because this overfishing definition applies the Fmax target to the available scallops, the size frequency distribution of landed scallops would be similar to that associated with the size structure expected when achieving maximum yield-per-recruit. The proportion of U10 landings to the total would increase from 15 percent in 2004 to the long-term average of about 35% by 2011. U10 and 10-20 count scallops combined would contribute to about 85% of total landings throughout the projection time series.

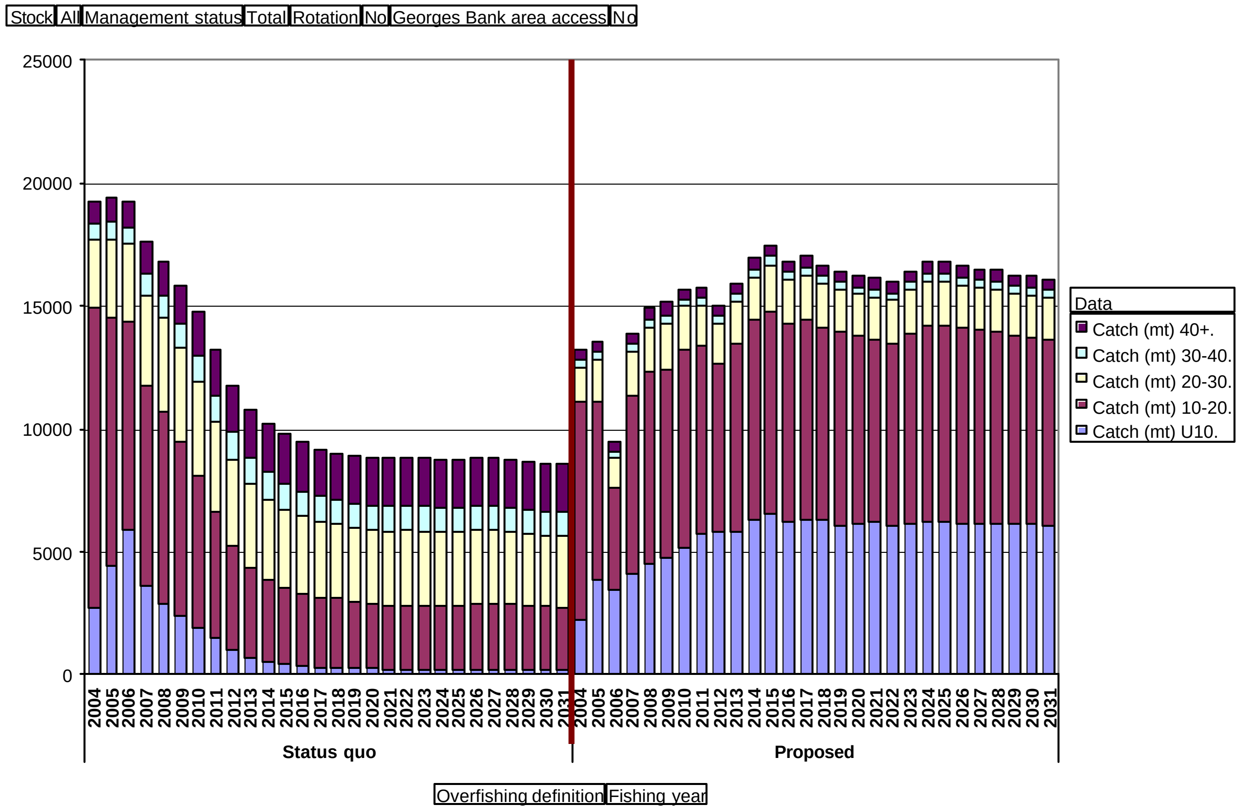


Figure 91. Projected landings (mt) for the status quo and alternative proposed overfishing definition, without rotation or access, and 3 ½ " rings. 20,000 mt is equivalent to 44.1 million lbs.

The final alternative ("Status quo – Yes – 4") with area rotation, but no Georges Bank access, the daily catches (LPUE) in open fishing areas are projected to decline from 1,721 – 1,747 lbs./day in 2003 and 2004 to less than 1,100 lbs./day beginning in 2005 (). Actually, without access, no rotation and 3 ½ " rings actually produces higher LPUE through 2009 than the final alternative. Projected LPUE is 1,679 to 1,892 lbs./day during 2004-2006, then declines to 1,066 lbs./day by 2009. After that, the final alternative ("Status quo – Yes – 4") is projected to produce higher LPUE.

The alternative proposed overfishing definition, in contrast, produces nearly the same catch rates as with access. Projected LPUE increases from 1,721 lbs./day in 2003 to around 2,300 lbs./day by 2007, even without access. Compared to the average LPUE with access, these projected catch rates are only slightly lower, reflecting the slightly lower productivity of areas outside of the Georges Bank closed areas.

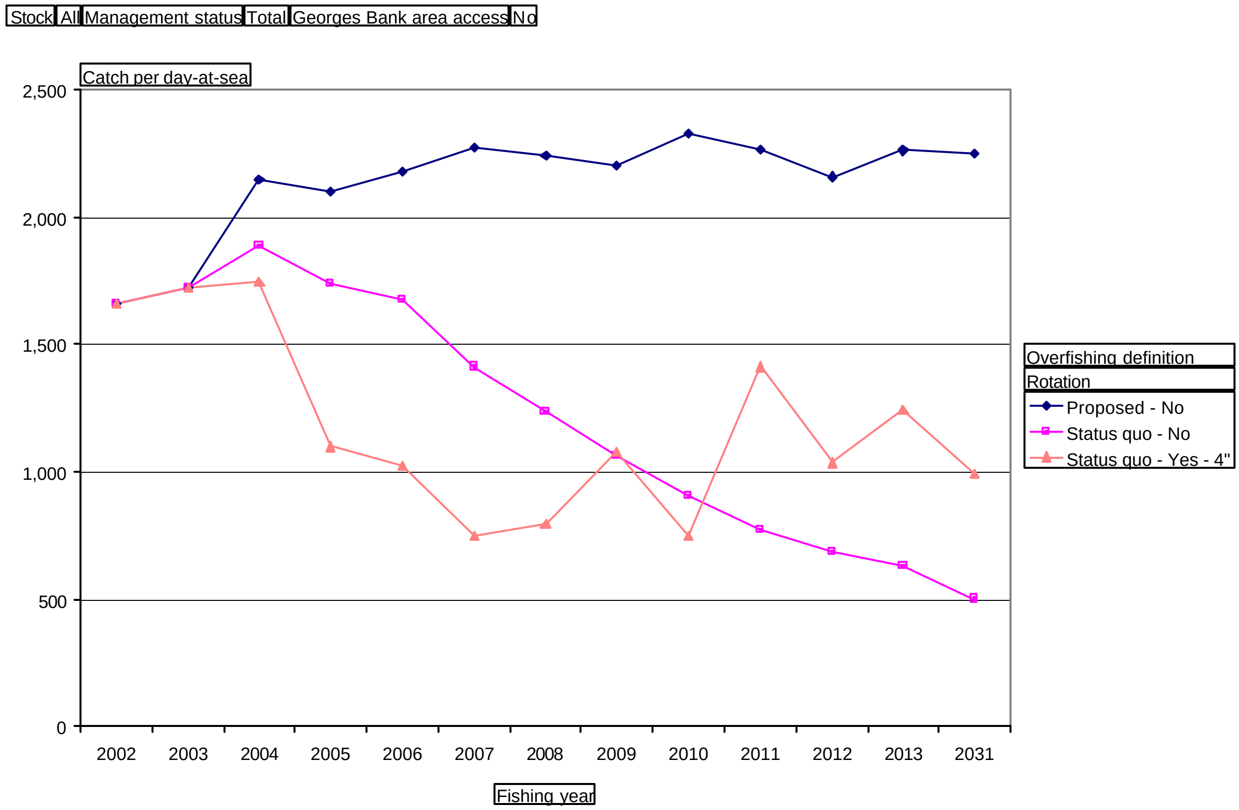


Figure 92. Trends in average catch rates (lbs./DAS) for limited access scallop vessels assuming no access to the Georges Bank closed areas.

8.2.3 Area-specific DAS and trip allocations

8.2.3.1 DAS allocations for open fishing areas

DAS allocations for open fishing areas were derived separately from those in controlled access areas, but treated similar to the DAS allocation procedures that have been applied since at least Amendment 7 for the 1998 fishing year. This procedure takes into account the number of vessels using days in the previous fishing year and the proportion of days allocated that they actually use. Since publication of the DSEIS, these data were updated for the VMS reports in the 2002 fishing year which were not yet available at that time. During 2002, active limited access scallop vessels, i.e. those using a scallop day-at-sea, were charged 85.3 percent of their annual day-at-sea allocations, assuming that they carried forward 10 days from the 2001 fishing year[71].

To evaluate how many DAS should be allocated to achieve a different DAS use target than was achieved in 2002, it was assumed that a limited access scallop vessel would use the number of days it was charged in 2002, unless the allocation to its permit class was less than the number of days used in 2002. In that case, it was assumed that the vessel would use all of its allocation. For potential full-time allocations more than 120, it was assumed that the DAS for that vessel would increase in the same

[71] According to law enforcement DAS data, the vast majority of limited access scallop vessels carry forward the maximum amount into the next fishing year.

proportion as the percent of days used in 2002 by that vessel. In other words, a vessel using 80 percent of 120 days allocated would use 80 percent of 135 days, or 108 days. In accordance with past Scallop FMP policies with regard to limited access DAS allocations, part-time scallop vessels receive 40 percent of the full-time DAS allocation and occasional vessels receive 1/12th of the full-time DAS allocation, both rounded to the nearest integer.

The final projection results by rotation management area, described above, were adjusted to take into account the overlap between the rotation management areas and controlled access areas, the latter having the DAS allocations adjusted for the 12 DAS/18,000 lb. tradeoff. The proposed rotation area management closure in the Mid-Atlantic (Section 5.1.3.3) has considerable overlap with rotation area management "MA4", which was assumed to have no fishing activity during 2004 – 2006. Rotation management areas "MA5" and "MA6" in the projections were assumed to overlap and account for the effort and landings from the Hudson Canyon Area, where a tradeoff would apply and the DAS allocations were handled through the procedure described in the section below.

The remaining day-at-sea estimates from the final projections in Section 8.2.2.3 were summed and the equivalent full-time, part-time, and occasional DAS allocations were calculated using the procedure described above in this section. The 2004 – 2006 results are shown in Table 166. The projected allowable DAS use values were adjusted by deducting a three percent set-aside to account for the program to fund at-sea observers, scallop research, and cooperative industry surveys. For example, in the open fishing areas, the 2004 target DAS use was 11,657 days which was reduced by 350 fishing days for the set-asides.

Using the relationship between days allocated to active fishing vessels and their actual DAS use, shown in Figure 93, the equivalent allocation for 11,307 days was 42 full-time, 17 part-time, and 4 occasional DAS. Similar calculations gave the results for 2005 and 2006, with and without access to the Georges Bank groundfish closed areas. As explained in the final projection summaries, the allowable DAS use in the open areas is higher than with access, because it takes more effort in the open areas to achieve a resource-wide F = 0.2 target when large areas are closed to fishing.

Table 166. Allowable open area DAS use to achieve the resource-wide target fishing mortality rates (F = 0.2), without and with access to Framework 13 parts of the Georges Bank closed areas.

	2004	2005	2006
DAS use without access	17,130	30,359	37,594
Less 3% set-aside	16,616	29,448	36,466
Full-time DAS allocation	62	117	152
Part-time DAS allocation	25	47	61
Occasional DAS allocation	5	10	13
DAS use with access	11,657	11,134	18,660
Less 3% set-aside	11,307	10,800	18,100
Full-time DAS allocation	42	40	67
Part-time DAS allocation	17	16	27
Occasional DAS allocation	4	3	6

8.2.3.2 Area-specific DAS allocations for controlled access fishing areas

Unlike the allowable DAS estimates for open areas which are a function of the catch that would achieve the annual target fishing mortality rate and the estimated landings per day-at-sea[72], the DAS allocations for controlled access areas were calculated directly from the estimated TACs. Swept-area biomass estimates were derived from the NMFS R/V Albatross survey data, which were often supplemented with additional tows in the controlled access areas to increase the precision of these estimates. Where appropriate, the SMAST video survey data were also used to estimate the TAC. Due to questions and concerns about some of the data, the PDT agreed that the best treatment of all data was to apply the size frequency information from the Albatross survey to the density estimates for both surveys, until the video survey size frequency data were peer reviewed by the SARC. The PDT furthermore decided that the SARC-reviewed, shell-height/meat-weight relationships should be used.

The total potential number of allocated trips was calculated by dividing the scallop possession limits into the TACs (after deducting a 3 percent set-aside to provide funds for scallop research, observers, and the cooperative industry survey), then allocating these trips to full-time, part-time, and occasional categories. The Council agreed that the policy that should apply to the three permit categories were that part-time vessels should be allocated 40 percent of the number of trips assigned to full-time vessels and occasional vessels should be allocated 1/12th the number of trips assigned to full-time vessels, both rounded down to the nearest integer number of trips as long as vessels received at least one trip per vessel. The Council also decided that the best approach would be to allocate a pool of controlled access trips and DAS that vessels may take to any controlled access area, but that there would be a maximum number of trips that a limited access scallop vessel may take for each area.

[72] Commercial landings per DAS were modeled using the historic relationship between survey abundance and commercial LPUE, as modified by a cap on landings per day-at-sea imposed by the crew size restriction. This cap varies with the expected average scallop size, but is roughly 50,000 scallops per vessel-day.

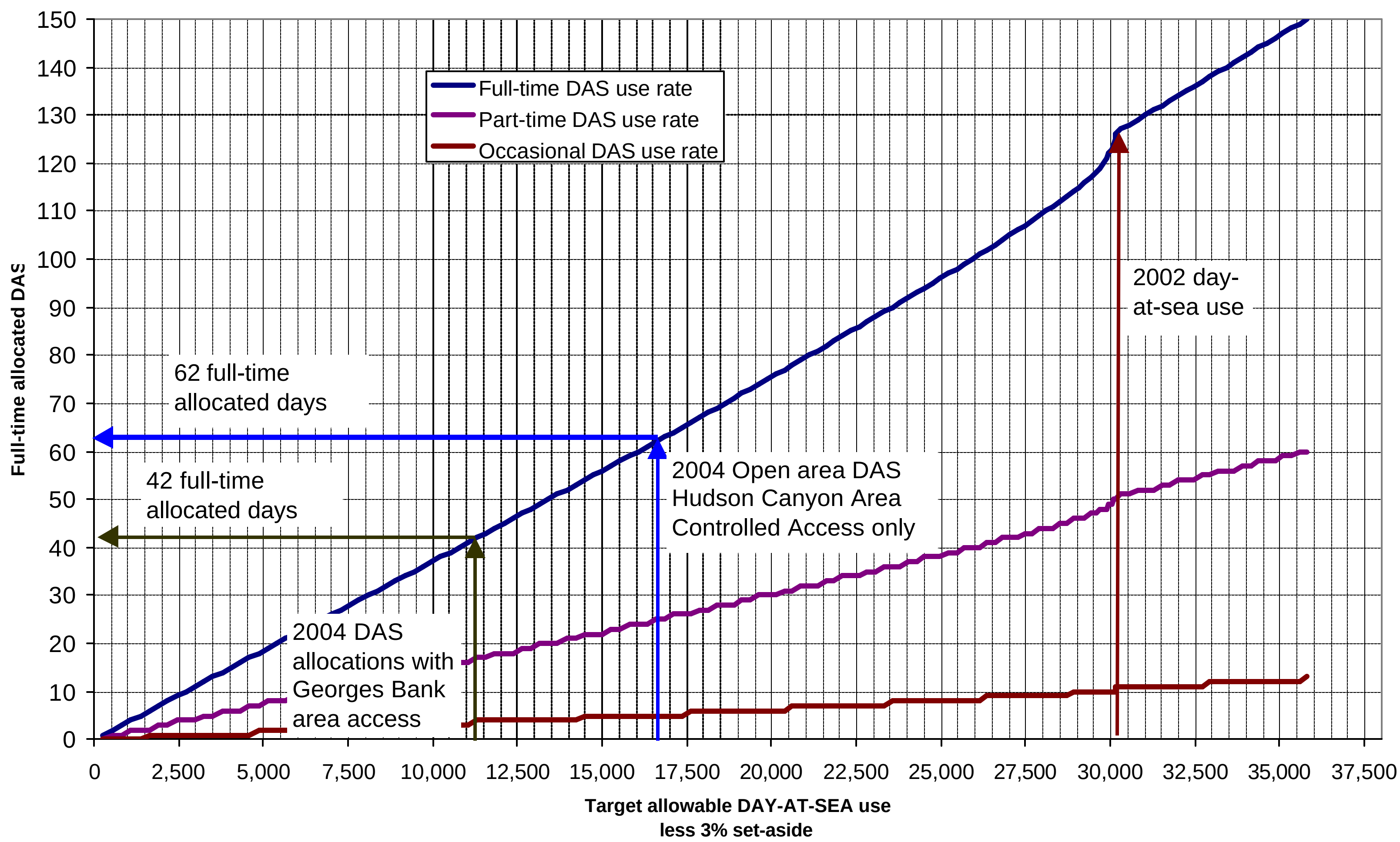


Figure 93. Calculation of limited access day-at-sea allocations from 2002 baseline day-at-sea estimates, applied to open area DAS use targets to achieve target fishing mortality rate.

This approach to allocating controlled access DAS and trips would avoid several potential problems. First, it would avoid allocating an unfairly large share of trips to part-time and occasional vessels if they were to receive no less than one trip in each area. In some cases, a full-time vessel might receive one or two trips, making the part-time and occasional allocation equal to 100 or 50 percent of the full-time allocation. Alternatively, this pooling procedure would avoid a potential regulatory burden of NMFS determining which area to allocate a trip or two to each part-time or occasional vessel, depending on its stated preference, possibly during the annual permit application process. Lastly, the pooled approach potentially reduces the need for part-time and occasional vessels to exchange trips with other vessels – they simply take the number of trips allocated provided that the total number of trips taken for a vessel does not exceed the number of allowable trips for each area.

Based on public testimony and advice, the Council also chose to apply a 1,500 lb/DAS tradeoff which was a 23 to 50 percent reduction compared to the expected LPUE in each controlled access area (see below). The length of the trip was evaluated with respect to this tradeoff and the one that gave the most profits per vessel was chosen (see Section 8.7.4.9). There were no biological implications of the tradeoff or the length of the trip, other than that associated with the proportion of the TAC that could be taken. Obviously, scallop fishing mortality, finfish bycatch, and bottom contact time all vary in direct proportion with the amount of the TAC that will be taken with the allocated trips.

In essence, the DAS tradeoff allows the plan to allocate more DAS than will actually be fished and unlike previous management the DAS cannot be fished outside of the controlled access areas. This procedure allows the FMP to allocate more DAS on paper than will actually be fished. Limited access scallop vessels will be allocated extra DAS in the controlled access areas and may fish at a more leisurely pace than when fishing elsewhere, because each trip will "burn" 12 DAS even though the trip will probably be much shorter if the crew and vessel were operating at capacity around the clock, like vessels do when fishing normally.

Using the average projected landing per day (LPUE) estimates for the controlled access areas and applying a 12 DAS/18,000 lbs. tradeoff implies that the average trip will last 7.2 days to land 18,000 lbs., a value that varies with the catch rates and crew's shucking capacity between areas, seasons, and vessels. In 2005 with controlled access for the Hudson Canyon Area and Closed Area II, the average trip length is expected to be 8.2 days to landing 18,000 lbs. of scallop meats.

The Council also decided based on public input that controlled access DAS should be allocated in trip-length blocks and unlike previous policy the controlled access DAS could not be used to fish in fully-open fishing areas. Even if limited access vessels take fewer controlled access trips than they are allocated, this decision will have a substantial conservation effect in open fishing areas and reduce scallop fishing mortality, which has been problematically high especially in the Mid-Atlantic region (Figure 94).

Applying the above formulation to the estimated TACs for controlled access areas (see below), the DAS allocations for the Hudson Canyon Area, which will remain under controlled access rules during 2004-2005, will be 48 days for full-time, 12 days for part-time, and 12 days for occasional vessels, equivalent to 4, 1, and 1 allocated trips respectively. This will decline to 36 DAS/3 trips for full-time and 12 DAS/1 trip for part-time and occasional vessels in 2005, because although the target fishing mortality will increase from 0.4 to 0.48, the TAC is estimated to decline from 18.8 million lbs. (8,523 mt) to 15.0 million lbs. (6,784 mt).

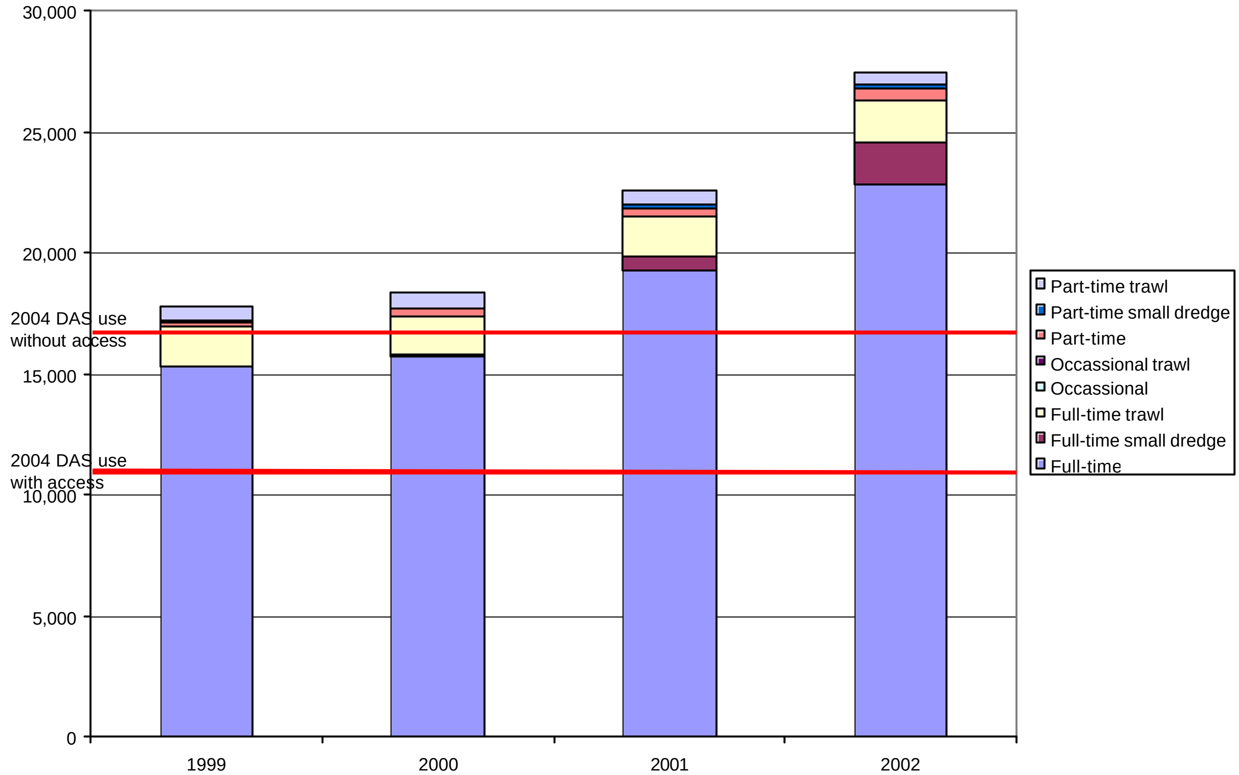


Figure 94. 1999 – 2000 DAS use by limited access vessels using VMS compared to total allowable DAS use for 2004 associated with 62 full-time DAS allocations without Georges Bank access and 42 full-time DAS allocations with Georges Bank access.

If Framework Adjustment 16/39 allows access to the groundfish closed areas in 2004 and beyond, the controlled access trips would increase from to seven trips, or 84 DAS in both 2004 and 2005, equivalent to 84 DAS. Part-time vessels would receive an increase from one to two trips, or 24 DAS, which may be fished in any open controlled access area as long as the trips taken do not exceed the maximum number of trips for each area.

During 2004, the maximum number of trips for limited access vessels to take will be 4 in the Hudson Canyon Area, and 2 trips in the Nantucket Lightship Area and 1 trip in Closed Area I pending approval of Framework Adjustment 16/39. In 2005, limited access vessels would be allowed to take a maximum of 3 trips in the Hudson Canyon Area and 4 trips in Closed Area II, the latter pending approval of Framework Adjustment 16/39. The Hudson Canyon Area is expected to convert to a fully-open status in 2006, making Closed Area II the only controlled access area for those years. Estimates based on the 2002 survey indicate that 4 trips and 48 DAS may be allowed during 2006 and 3 trips and 36 DAS during 2007 for full-time vessels. When the Mid-Atlantic "Elephant Trunk Area" will be ready for re-opening is uncertain, but generally the projection analyses in Section 8.2.1.3 suggest that a three-year closure provides satisfactory results in terms of optimizing yield-per-recruit. On the other hand, the Council may vary the time when closed rotation management areas re-open under controlled access rules, depending on actual resource conditions and rotation management outlook.

Table 167. Maximum number of limited access trips by controlled access area and number of allocated trips and DAS by permit category, assuming approval of Framework Adjustment 16/39 to allow access to the Georges Bank groundfish closed areas.

	2004		2005		2006		2007	
	Trips	DAS	Trips	DAS	Trips	DAS	Trips	DAS
Hudson Canyon Area	4		3		NA		NA	
Nantucket Lightship Area	2		Closed		Closed		Closed	
Closed Area I	1		Closed		Closed		Closed	
Closed Area II	Closed		4		4		3	
Full-time	7	84	7	84	4	48	3	36
Part-time	2	24	2	24	1	12	1	12
Occasional	1	12	1	12	1	12	1	12

8.2.3.3 TAC estimates from R/V Albatross dredge survey and video survey data

The Scallop PDT reviewed and compared the video survey with the dredge survey data. One conspicuous difference was first identified in the size frequency data for the Nantucket Lightship Area. It was observed that the video survey data had measurements of scallops that did not appear in the dredge survey data, the former observing scallops between 180 and 205 mm. Also, it appeared that the video survey year class peaks were not well correlated with those observed in the dredge survey.

Despite a more thorough validation by Dr. Stokesbury and SMAST, the cause of these differences could not be explained and were found to be even more wide-spread when comparing the size frequency distributions for other areas and years. This latter effort compared the size frequency distributions for the Albatross tow stations that coincided with the boundaries of the SMAST video surveys that were also in the Framework Adjustment 13 area access boundaries.

The PDT recommended that the video survey abundance densities be merged (i.e. a weighted average) with the Albatross densities to estimate area access TACs. This was done for the 2002 data for the Nantucket Lightship Area, but not for other areas with surveys in 2001 or earlier. The PDT also recommended using the SAW 29 shell height meat weight relationships.

In addition, the biomass and TAC estimates using the SMAST video survey length frequencies, applying a commercial ogive from SAW 20 and the SAW 29 shell height meat weight relationships were estimated for comparison. While the video-survey based estimates were higher for the Nantucket Lightship Area and Closed Area II, in the end it really didn't make a difference (see Table 170) as the increased TAC did not allow for allocations of more trips for area access.

Nonetheless, the video survey estimates improve the precision of the estimate because many more samples are taken. Furthermore, the video survey can be very helpful in distinguishing the boundaries of beds of similar size or small scallops, as was done to evaluate the proposed Mid-Atlantic rotation area management closure, above.

Three explanations remain that relate to the observed differences between the size frequencies for the two surveys:

The video size frequency data is smoothed and affected by random and systematic sampling error. The random error was estimated by SMAST to be about 5 percent. A systematic error results from the step function assumed to correct for lens diffraction in salt water. Photogrammetry methods might be explored to address both of these error sources.

Length frequency sampling error on the dredge survey has not been estimated, but may also apply.

The lined survey dredge and the commercial dredge may not catch the very large scallops that are observable in the video survey. Even though Dr. Stokesbury had samples of shells approaching 200 mm, these very large scallops have not been observed in the commercial dredge samples taken by Dr. DuPaul and have not been observed in the dredge survey. This possibility, by the way, suggests a dome shaped partial recruitment curve if very large scallops are not available to the fishery.

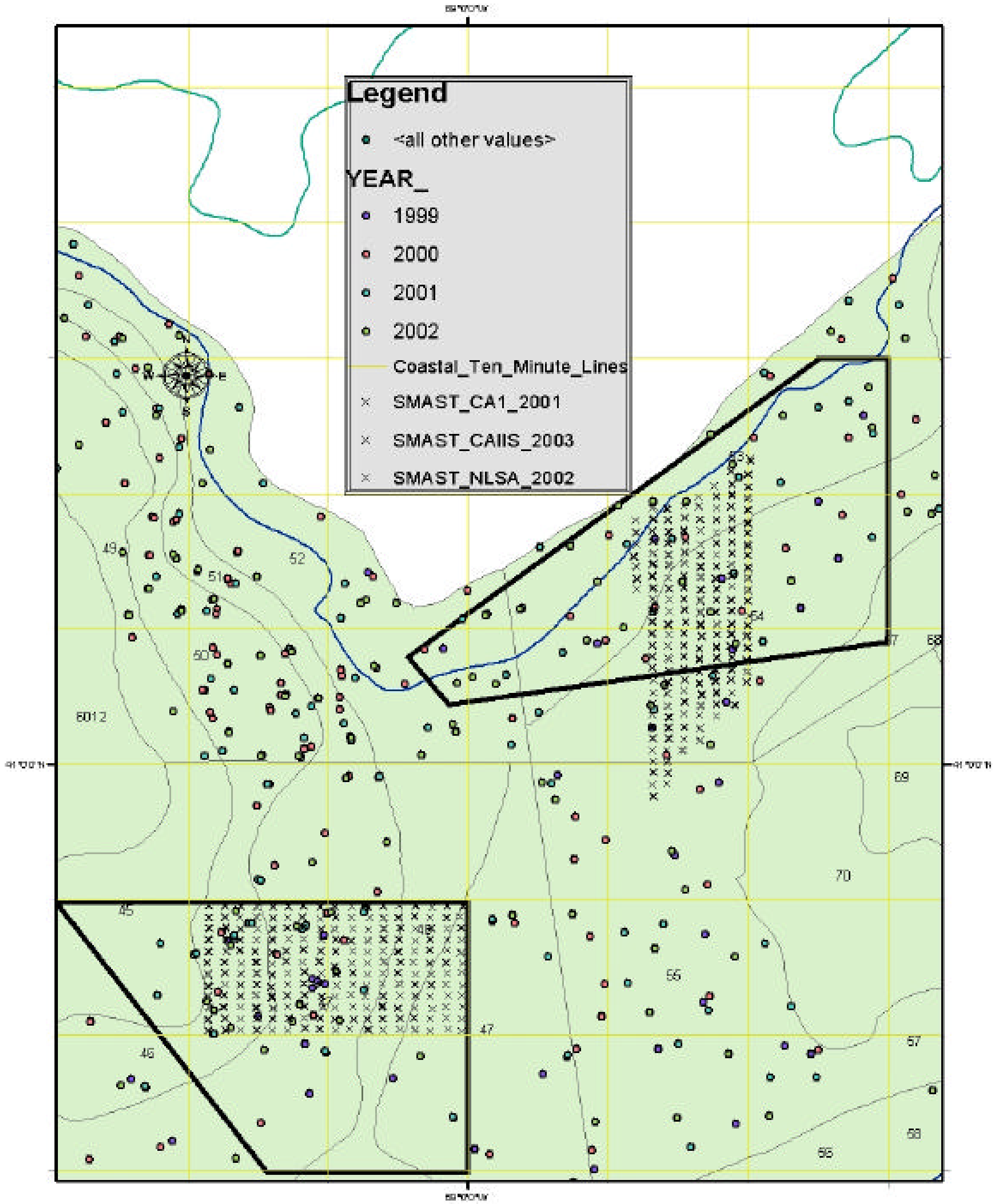


Figure 95. Comparison of SMAST video survey stations with NMFS R/V Albatross scallop survey tow locations and proposed area access boundaries for Closed Area I and Nantucket Lightship Area.

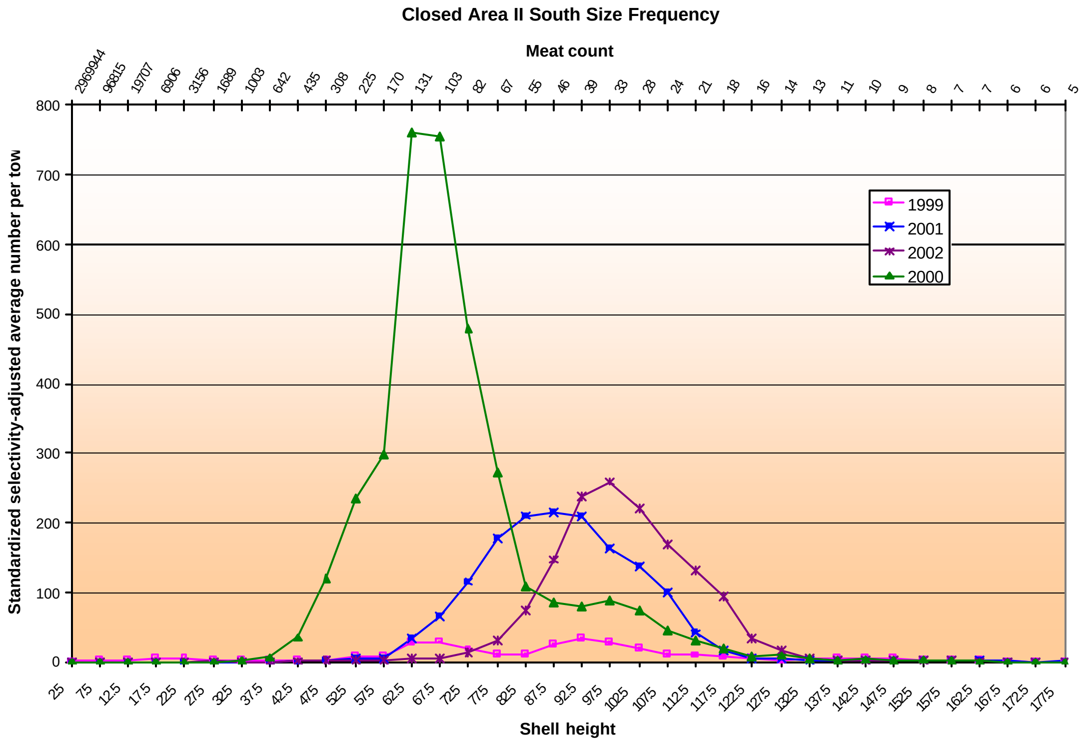


Figure 96. Shell height and meat count size frequency distribution of R/V Albatross scallop survey tows in Closed Area II South (GB14).

Table 168. Video survey based TAC estimates with a 0.2 fishing mortality target.

Video survey estimate	Selectivity / Year		*NLSA02*	*CA12001*	*CA2S2001*
Average MEAT WEIGHT	All		36.91	26.00	11.30
	90+		40.17	27.60	14.55
	Full recruits		39.46	27.20	12.74
	Full & partial		38.24	26.65	11.36
	Full & partial < 180		36.39	26.42	11.36
Density	All		0.820	0.35	1.07
	90+		0.744	0.326	0.636
	Full recruits		0.761	0.000	0.000
	Full & partial		0.790	0.341	1.062
	Full & partial < 180		0.773	0.339	1.062
	Ratio of biomass density without < 180 mm		93%	99%	100%
Fishable area (km^2)			1,356	1,250	4,327
Fishable area (nm^2)			395	365	1,261
Surveyed area (km)			504	405	153
2001/2002 Baseline (mt):			4996	5256	31747
2004 Baseline (mt):			10277	4671	49729
Exploitable biomass change to 2004		2004	103.2%	111.8%	167.0%
Projected change in exploitable biomas		2005	84.6%	86.7%	97.2%
		2006	72.5%	76.9%	90.8%
		2007	63.2%	69.8%	84.1%
	Target F = 0.2				
Estimated exploitable biomass		2004	15,724	4,110	58,444
TAC estimates (mt)		2004	2,818	752	11,217
		2005	2,383	652	10,904
		2006	2,042	578	10,189
		2007	1,782	525	9,438

The biomass estimates and associated TACs above are based on the video survey size frequencies for the Nantucket Lightship Area in 2002 and in Closed Area I in 2001. Both exploitable biomass estimates are projected forward by applying the ratio of exploitable biomass estimates for the projections to 2004 to 2007. The biomass estimates for Closed Area II were based on the R/V Albatross mean catch per tow in 5 mm increments. This estimate, however, is probably an overestimate of the true value – either in 2001 or projected forward into 2004. During the 2001 video survey, SMAST sampled a subsection of Closed Area II South – the part that had the high concentrations of sea scallops. In comparison, the SMAST data for Closed Area II South in 2003 measured 0.2 scallops per m2, which using the SMAST estimates equates to only 21,980 mt, compared with the 61,153 mt of biomass estimated here from the 2001 video survey densities. During the surveys, SMAST also observed an elevated clapper ratio of about 14%.

For all three areas, the applicable shell height meat weight relationships from SAW 29 were applied and various selectivity ogives were applied to determine average meat weight and abundance density. The commercial cull ogive estimated by SAW 20 was also applied to estimate the total biomass of exploitable scallops and TACs were estimated by applying Baranov's catch equation (Baranov 1918).

To compare the effect that greater than 180 mm scallops (observed by the video survey, but not by the dredge survey or in the commercial catch), an ogive was applied that assumed no commercial catches of scallops greater than 180 mm. Doing so for the Nantucket Lightship Area reduced the abundance density by 7 percent and would have reduced the biomass estimate and TAC by 11 percent (because the average meat weight of the catch is smaller). This effect was smaller in the Closed Area I, because the video survey observed a smaller fraction of the catch above 180 mm.

Table 169. Video survey based TAC estimates with a 0.4 fishing mortality target.

Video survey estimate	Selectivity / Year		*NLSA02*	*CA12001*	*CA2S2001*
Average MEAT WEIGHT	All		36.91	26.00	11.30
	90+		40.17	27.60	14.55
	Full recruits		39.46	27.20	12.74
	Full & partial		38.24	26.65	11.36
	Full & partial < 180		36.39	26.42	11.36
Density	All		0.820	0.35	1.07
	90+		0.744	0.326	0.636
	Full recruits		0.761	0.000	0.000
	Full & partial		0.790	0.341	1.062
	Full & partial < 180		0.773	0.339	1.062
	Ratio of biomass density without < 180 mm		93%	99%	100%
Fishable area (km^2)			1,356	1,250	4,327
Fishable area (nm^2)			395	365	1,261
Surveyed area (km)			504	405	153
2001/2002 Baseline (mt):			4996	5256	31747
2004 Baseline (mt):			10277	4671	49729
Exploitable biomass change to 2004		2004	103.2%	111.8%	167.0%
Projected change in exploitable biomas		2005	71.1%	73.0%	97.2%
		2006	75.2%	79.7%	90.8%
		2007	80.1%	87.8%	84.1%
Target F = 0.4					
Estimated exploitable biomass		2004	15,724	4,110	58,444
TAC estimates (mt)		2004	5,090	1,427	20,435
		2005	3,619	1,042	19,864
		2006	3,829	1,137	18,562
		2007	4,076	1,253	17,193

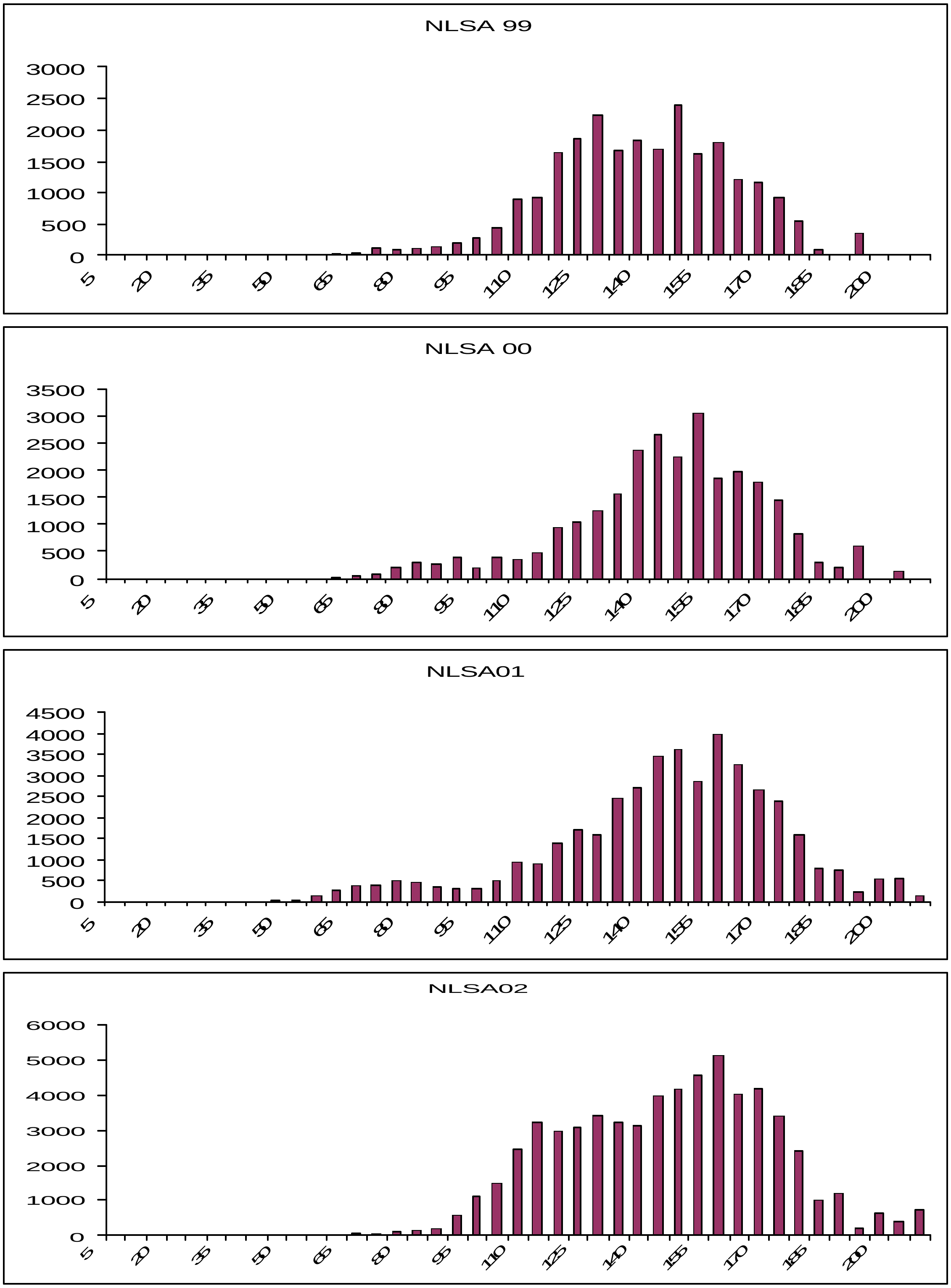


Figure 97. Total observed biomass size frequencies for Nantucket Lightship Area video surveys.

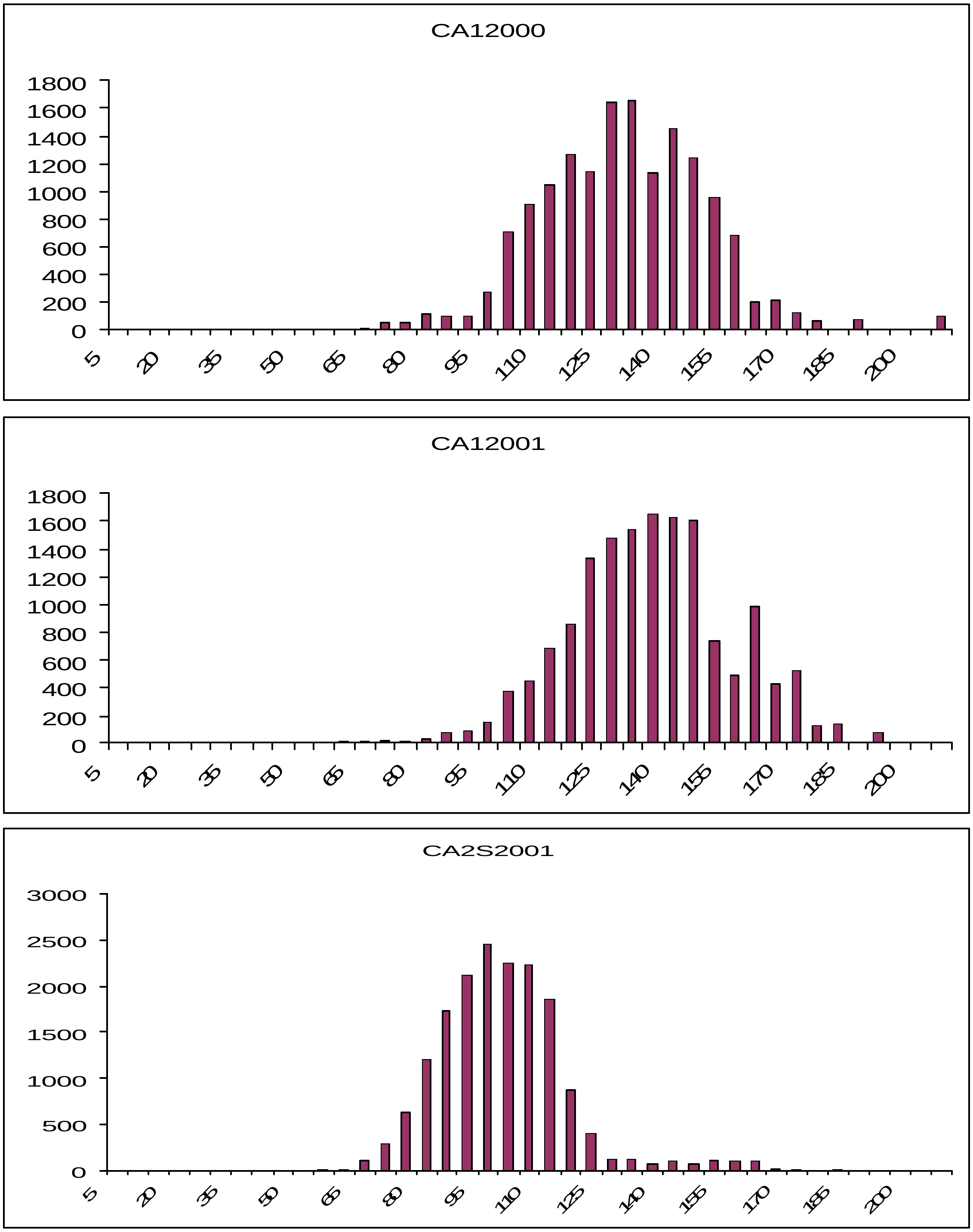


Figure 98. Total observed biomass size frequencies for Closed Area I and II video surveys. R/V Albatross scallop abundance size frequency was substituted for the video survey for Closed Area II, for estimating the TACs in this document.

Table 170. Biomass and TAC estimates by area and year for various fishing mortality targets. TACs for fishing mortality targets above 0.4, assumed that the area was fished at 0.4 in the previous years of the projection.

2004 TACs

	2004 projected biomass (mt)	Fishing mortality target: 0.2	Video	0.4	Video	0.48	0.6	0.8
Hudson Canyon Area	21729	4,678		8,523		9,861	11,683	14,282
Closed Area I	4671	855	752	1,622	1,427	1,877	2,224	2,719
Closed Area II South	49729	9,545	11,217	16,615	20,435	19,238	22,814	27,934
Nantucket Lightship Area	10277	1,842	2,818	3,327	5,090	3,850	4,561	5,575

2005 TACs

	2005 projected biomass (mt)		Fishing mortality target						
Target F in 2004	Alternative 3: F=0.2	Alternative 1: F=0.4	0.2	Video	0.4	Video	0.48	0.6	0.8
Hudson Canyon Area		17295	3,724		6,784		7,849	9,299	11,368
Closed Area I	4048	3410	741	652	1,406	1,042	1,627	1,927	2,356
Closed Area II South	48340		9,278	10,904	16,151	19,864	18,701	22,177	27,154
Nantucket Lightship Area	8691	7306	1,557	2,383	2,813	3,619	3,255	3,857	4,715

2006 TACs

	2006 projected biomass (mt)		Fishing mortality target						
Target F in 2004 - 2005	Alternative 3: F=0.2	Alternative 1: F=0.4	0.2	Video	0.4	Video	0.48	0.6	0.8
Hudson Canyon Area		13776	2,966		5,403		6,252	7,407	9,054
Closed Area I	3591	3722	657	578	1,247	1,137	1,443	1,710	2,090
Closed Area II South	45171		8,670	10,189	15,093	18,562	17,475	20,723	25,374
Nantucket Lightship Area	7446	7731	1,334	2,042	2,410	3,829	2,789	3,304	4,039

2007 TACs

	2007 projected biomass (mt)		Fishing mortality target						
Target F in 2004 - 2006	Alternative 3: F=0.2	Alternative 1: F=0.4	0.2	Video	0.4	Video	0.48	0.6	0.8
Hudson Canyon Area		10352	2,229		4,060		4,698	5,566	6,804
Closed Area I	3259	4100	597	525	1,132	1,253	1,310	1,552	1,897
Closed Area II South	41839		8,030	9,438	13,979	17,193	16,186	19,194	23,502
Nantucket Lightship Area	6500	8229	1,165	1,782	2,104	4,076	2,435	2,885	3,526

The Nantucket Lightship Area projected TAC is a weighted average of the dredge survey and video survey estimates. Video survey TAC estimates were derived by applying the SAW 29 shell height meat weight relationships and a commercial cull ogive to the video survey size frequencies, except for Closed Area II where the R/V Albatross size frequencies were substituted.

Table 171. Projected biomasses and catches in controlled access areas by year.

2004 Projected Biomasses and Catches in Closed/Access Areas

21000
310

Area	Fishing mortality	Exploitable biomass (mt)	Mean exploitable weight (g)	Landings (mt)	Landings, video adjusted (mt)	Catch per day used	Allowable days used	Trips (21,000 lbs; 310 vessels)	Days accumulated	Area swept (nm^2)
Hudson Canyon Area	0.4	21729	21.7	8523	8523	2451	7,666	3	8,948	657
Closed Area I (GB9)	0.4	4671	30.8	1622	1622	2279	1,569	1	1,703	235
Nantucket Lightship Area (GB12)	0.4	10277	40.4	3327	3685	3024	2,687	1	3,869	75
Closed Area I (GB9)	0.2	4671	28.4	855	855	2398	786	0	898	117
Closed Area II (GB14)	0.2	49729	30.8	9545	9545	2666	7,893	3	10,021	292
Nantucket Lightship Area (GB12)	0.2	10277	40.4	1842	2040	3064	1,468	1	2,142	37
				GB9 & GB12	5307	2749	4,256	2	5,571	310

2004 Projected Biomasses and Catches in Closed/Access Areas based on video only

Area	Fishing mortality	Exploitable biomass (mt)	Mean exploitable weight (g) during survey	Landings (mt)	Landings, video adjusted (mt)	Catch per day used	Allowable days used	Trips (21,000 lbs; 310 vessels)	Days accumulated	Area swept (nm^2)
Hudson Canyon Area						2451				
Closed Area I (GB9)	0.4	4109	26.65	1622	1427	2279	1,380	0	1,498	
Nantucket Lightship Area (GB12)	0.4	14195	38.24	3327	5090	3024	3,711	2	5,344	
Closed Area I (GB9)	0.2	4108	26.65	855	752	2398	691	0	789	
Closed Area II (GB14)	0.2	58440	11.36	9545	11217	2666	9,276	4	11,776	
Nantucket Lightship Area (GB12)	0.2	14196	38.24	1842	2818	3064	2,028	1	2,958	
				GB9 & GB12	6517	2822	5,091	2	6,842	-

2005 Projected Biomasses and Catches in Closed/Access Areas

21000
310

Area	Fishing mortality	Exploitable biomass (mt)	Mean exploitable weight (g)	Landings (mt)	Landings, video adjusted (mt)	Catch per day used	Allowable days used	Trips (21,000 lbs; 310 vessels)	Days accumulated	Area swept (nm^2)
Hudson Canyon Area	0.48	17295		6784	6784	1951	7,666	2	7,122	
Closed Area I (GB9)	0.4	3410		1406	1406	1664	1,863	0	1,476	
Nantucket Lightship Area (GB12)	0.4	7306		2813	3116	2150	3,195	1	3,271	
Closed Area I (GB9)	0.2	4048		741	741	2078	786	0	778	
Closed Area II (GB14)	0.2	48340		9278	9278	2592	7,893	3	9,740	
Nantucket Lightship Area (GB12)	0.2	8691		1557	1724	2591	1,467	1	1,810	
				HCA & GB1	16062	2276	15,559	5	16,862	-

2006 Projected Biomasses and Catches in Closed/Access Areas

21000
310

Area	Fishing mortality	Exploitable biomass (mt)	Mean exploitable weight (g)	Landings (mt)	Landings, video adjusted (mt)	Catch per day used	Allowable days used	Trips (21,000 lbs; 310 vessels)	Days accumulated	Area swept (nm^2)
Hudson Canyon Area	0.48	13776		5403	5403	1554	7,666	2	5,672	
Closed Area I (GB9)	0.4	3722		1247	1247	1816	1,514	0	1,309	
Nantucket Lightship Area (GB12)	0.4	7731		2410	2669	2275	2,587	1	2,802	
Closed Area I (GB9)	0.2	3591		657	657	1844	786	0	690	
Closed Area II (GB14)	0.2	45171		8670	8670	2422	7,893	3	9,102	
Nantucket Lightship Area (GB12)	0.2	7446		1334	1477	2220	1,467	1	1,551	
				HCA & GB1	14073	1994	15,559	5	14,774	-

2007 Projected Biomasses and Catches in Closed/Access Areas

21000
310

Area	Fishing mortality	Exploitable biomass (mt)	Mean exploitable weight (g)	Landings (mt)	Landings, video adjusted (mt)	Catch per day used	Allowable days used	Trips (21,000 lbs; 310 vessels)	Days accumulated	Area swept (nm^2)
Hudson Canyon Area	0.48	10352		4060	4060	1168	7,665	1	4,262	
Closed Area I (GB9)	0.4	4100		1132	1132	2000	1,248	0	1,188	
Nantucket Lightship Area (GB12)	0.4	8229		2104	2330	2421	2,122	1	2,447	
Closed Area I (GB9)	0.2	3259		597	597	1673	787	0	627	
Closed Area II (GB14)	0.2	41839		8030	8030	2243	7,893	3	8,430	
Nantucket Lightship Area (GB12)	0.2	6500		1165	1290	1938	1,468	0	1,355	
				HCA & GB1	12090	1713	15,558	4	12,692	-

The second table above uses the biomass and TAC estimates derived from the video survey length frequencies for comparison. Although the TACs are slightly higher, the video survey would not increase the number of trips, except for Closed Area II, but that area would benefit from a revised size frequency estimate in 2002 or 2003.

The Scallop PDT numerically averaged the density estimates derived from the 2002 R/V Albatross and SMAST video survey to derive the TAC estimate for the Nantucket Lightship Area. Video survey data from 2001 and earlier were not used in the TAC estimation for any area due to potential resource changes during the interim. Using the SARC approved shell-height/meat weight relationships and the RV Albatross shell-height frequencies, the accepted TACs that apply to the final alternative for controlled access areas are shown in Table 172.

Table 172. Total allowable catches (TAC) and estimated average catch per DAS (LPUE) for 2004-2007 based on 2002 survey data within the proposed controlled access areas.

		2004	2005	2006	2007
Hudson Canyon Area	TAC (mt)	8,523	6,784	NA[73]	NA
	TAC (million lbs.)	18.8	15.0		
	LPUE (lbs.)	2,451	1,951		
Nantucket Lightship Area	TAC (mt)	3,685	Closed	Closed	Closed
	TAC (million lbs.)	8.1			
	LPUE (lbs.)	3,024			
Closed Area I	TAC (mt)	1,622	Closed	Closed	Closed
	TAC (million lbs.)	3.6			
	LPUE (lbs.)	2,279			
Closed Area II	TAC (mt)	Closed	9,278	8,670	8,030
	TAC (million lbs.)		20.5	19.1	17.7
	LPUE (lbs.)		2,592	2,422	2,243

8.2.3.4 Day-at-sea and trip allocations for both overfishing definitions, with and without access and area rotation

The estimates in the figures below, allow calculation of the trip and day-at-sea allocations for a variety of possession limit with a 10 DAS charge, while taking into account the number of permits and days-at-sea used by active vessels. In the first series of figures below (one for each year, plus alternative 3 in 2004), the number of trips and the effect of the day-at-sea tradeoff is calculated for scallop possession limits ranging from 15,000 to 26,000 lbs, assuming a 10 DAS charge for each controlled access trip.

Ultimately, the Council selected a 12 DAS charge and an 18,000 lbs. scallop possession limit based on public testimony and further economic analysis (Section 8.7.4.9). This analysis is presented here, however, to show the range of analyses that the Council considered in making its decision and the relative effect of tradeoffs other than 1,500 lbs./DAS, or 18,000 lbs. for 12 DAS.

As the possession limit increases, the number of allocable trips declines because the TAC is divided by a larger amount – i.e. the possession limit. The figures below show the number of trips for each area that could be allocated. This has included the PDT recommendation above that the number of trips be rounded up, not down, assuming the selection of DAS allocation alternative 2 (Section 5.3.3.2). In the end, however, the Council selected DAS allocation alternative 1, with area specific DAS allocations, obviating the need for hard TACs. As a result, the Council did not approve the rounding up policy recommended by the PDT when a hard TAC applied and instead approved the simple rounding procedure for determining the number of trips to be allocated to limited access vessels.

As the possession limit increases, the effect of the day-at-sea tradeoff declines – because it is expected to take longer for the average vessel to take a controlled access trip. This calculation is based on

[73] NA = Not applicable – are expected to convert to fully-open fishing area in 2006.

the estimated average LPUE from the projection model. If the possession limit is more than 10 times the daily LPUE, then the average trip will take longer than 10 days and there would be no tradeoff to add to the annual allocation. Alternatively, if vessels would be charged 10 days for a controlled access taking 12 days, for example, it could mean that the tradeoff is a subtraction from the annual allocation.

The above projections estimate a baseline total amount of days to be used by the fishery. To get to a day-at-sea allocation, days allocated to inactive vessels and to vessels that use less than 100 percent of their days are taken into account, following procedures the Council used in Frameworks 11 to 15. Lower scallop possession limits mean that the controlled access trips would be shorter, and vessels would be charged 10 days for a shorter trip. The projections estimate actual days used – not the tradeoff – so these extra days are added onto the annual allocation.

The figures below show the extra tradeoff days for each limited access permit and scallop possession limit, for each year in access alternative 1 and for alternative 3 in 2004. These days are added onto the annual allocation for that permit that is calculated directly from the estimated days used in the projections.

During 2004 to 2007, a 21,000 lb. scallop possession limit always creates a day-at-sea tradeoff, that can be added to the annual baseline allocation. It can be increased, but the day-at-sea tradeoff decreases and reduces the annual day-at-sea allocation, which is the sum of the baseline days used in open fishing areas and controlled access areas and the day-at-sea tradeoff, which is charged to the vessel, but not actually contributes to fishing time on controlled access trips.

A 24,000 lb. trip limit, for example reduces the full-time day-at-sea tradeoff from 11 to 4 days, thus reducing the annual allocation by seven days in 2004. In 2006 and 2007, on the other hand, the day-at-sea tradeoff would be zero or negative. Decreasing the scallop possession limit to add days would simply make it less attractive to fish in the controlled access program, compared to fishing in open fishing areas where the daily catches are higher.

Fortunately, while a 21,000 lb. scallop possession limit may not be sufficiently attractive in 2004, it becomes more attractive to fishermen after that when the daily catches in open areas is expected to decline. This effect is a very robust feature of the system, because it attracts more effort to re-opened areas as catch rates decline from high mortality rates elsewhere.

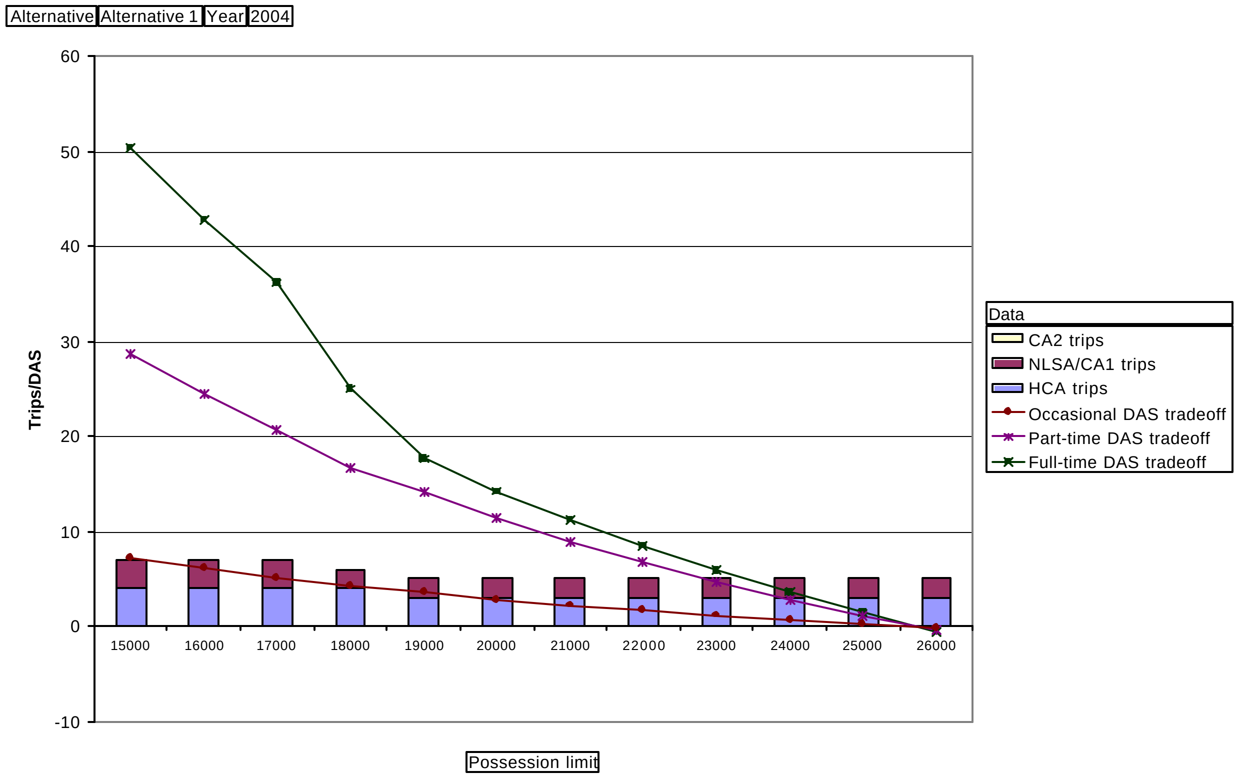


Figure 99. Trips and day-at-sea tradeoffs for 2004, area access alternative 1.

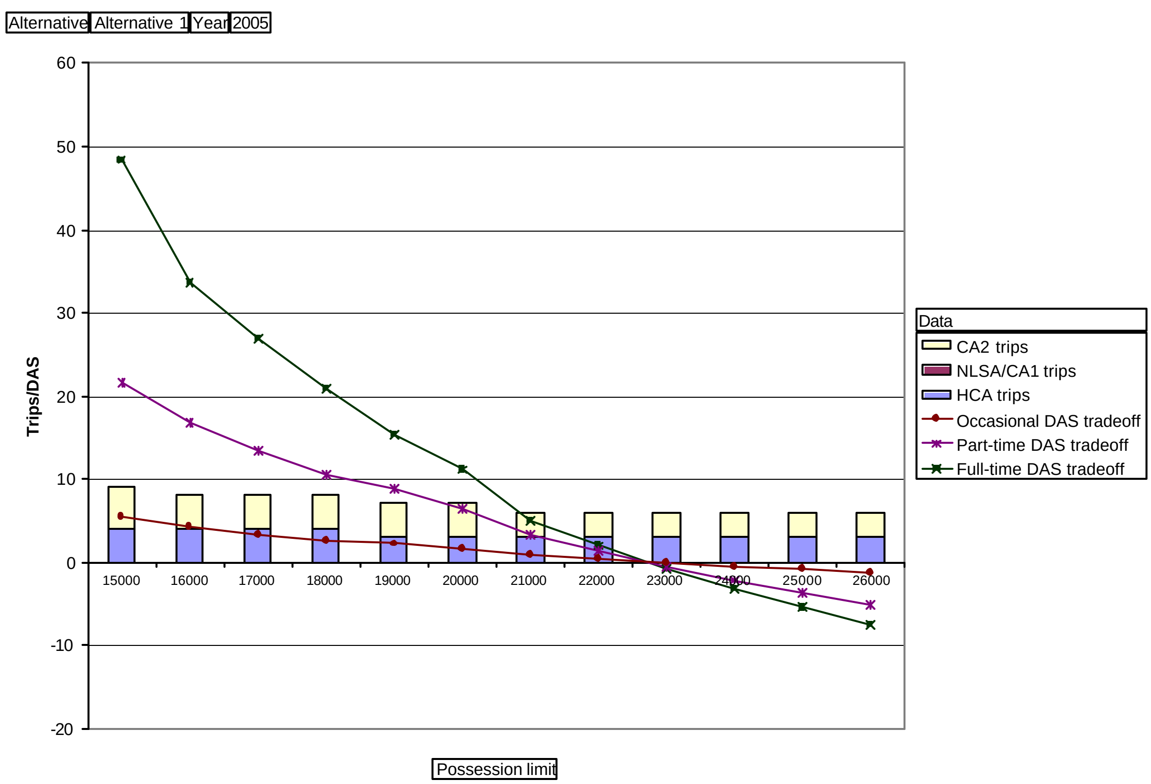


Figure 100. Trips and day-at-sea tradeoffs for 2005, area access alternative 1.

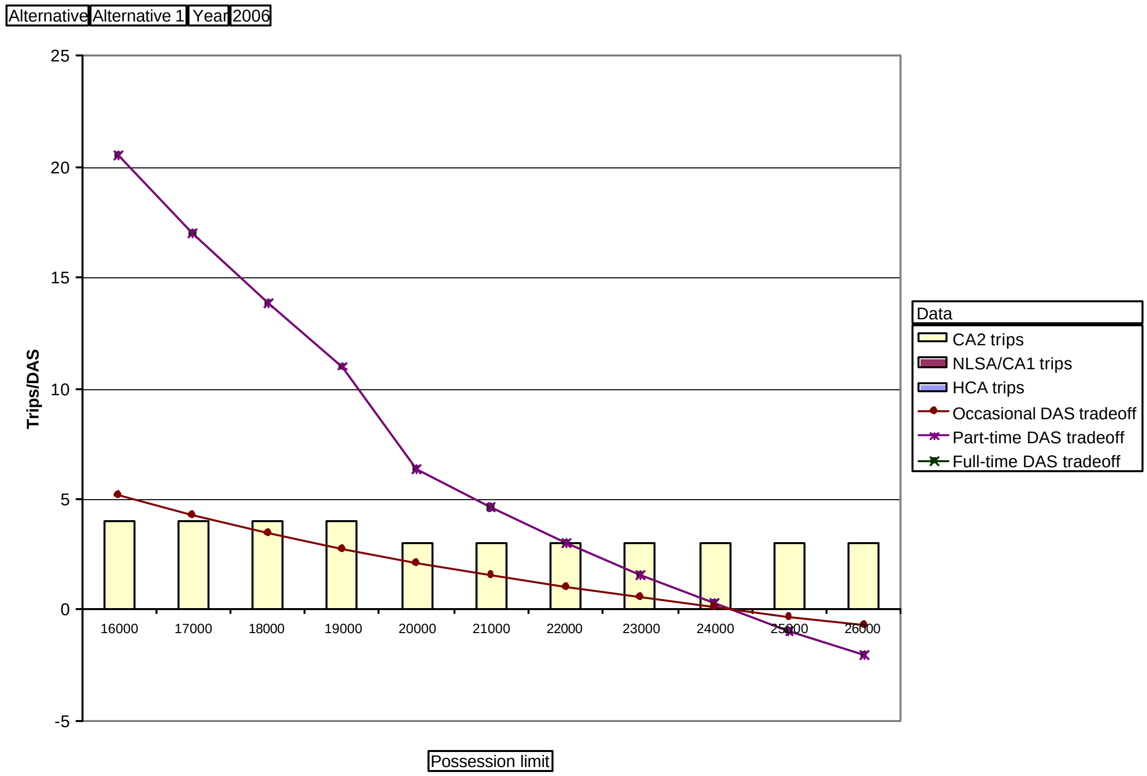


Figure 101. Trips and day-at-sea tradeoffs for 2006, area access alternative 1

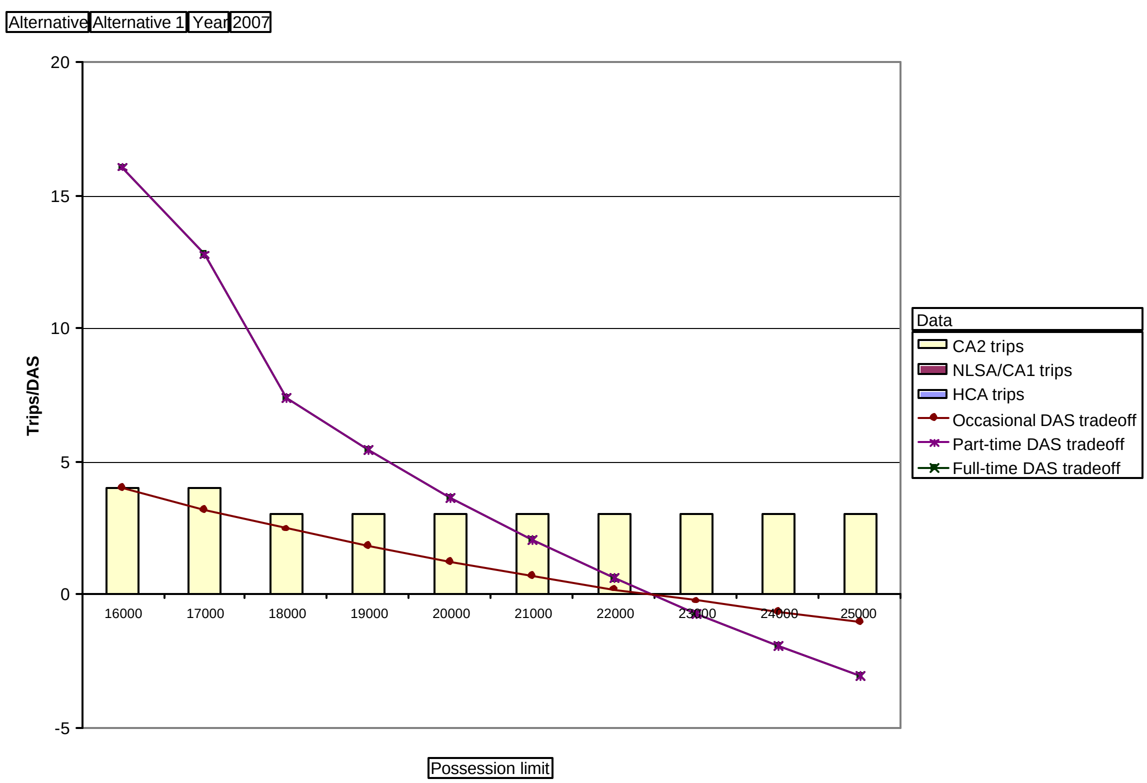


Figure 102. Trips and day-at-sea tradeoffs for 2007, area access alternative 1.

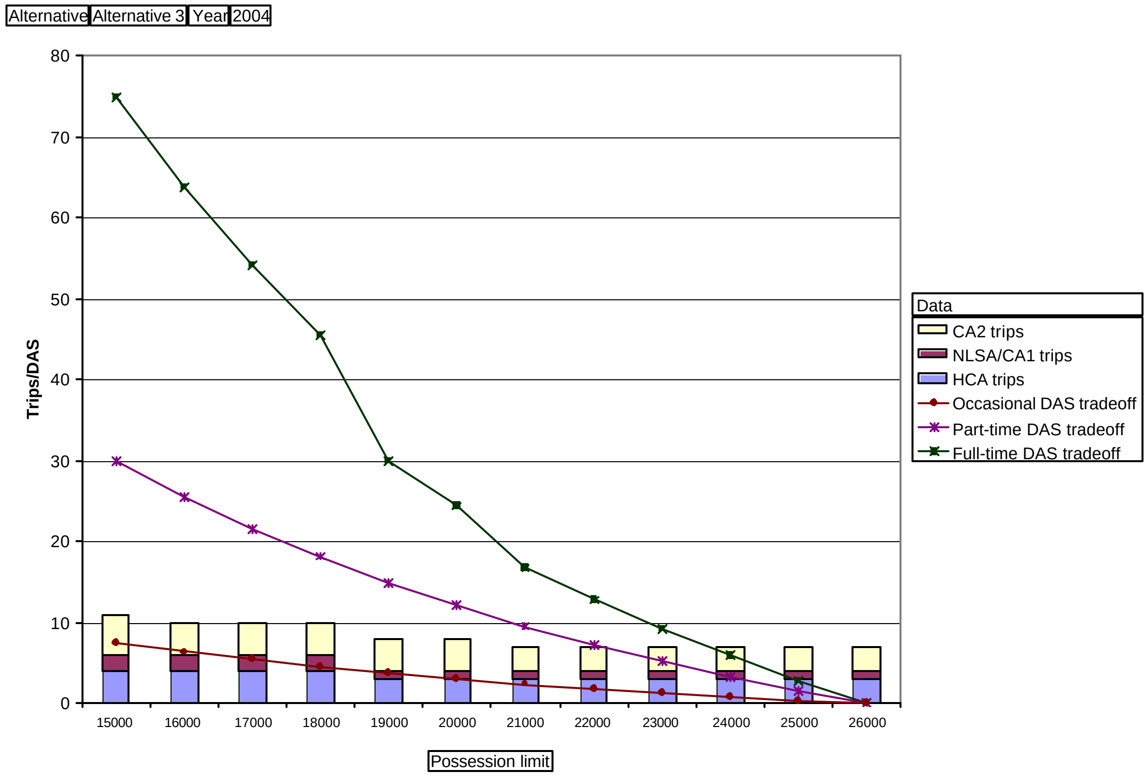


Figure 103. Trips and day-at-sea tradeoffs for 2004, area access alternative 3.

8.2.3.5 Varying controlled access trip lengths with a 1,500 lbs./DAS scallop possession limit equivalent

Narrowing the focus of the final alternative, the Council sought additional information on the effect of varying the length of controlled access trips using possession limits that were equivalent to a 1,500 lb./DAS cap. Thus for trips ranging from 8 to 15 DAS, the scallop possession limit would range from 12,000.

Using the table of results for the 2004 controlled access program (Table 173) as an example, the maximum number of limited access trips that could be allocated for the Hudson Canyon Area ranged from five to three trips, which decline in number because a higher scallop possession limit is divided into a constant TAC, which was reduced by 3 percent to account for the set-aside programs. The number of trips ranges from two to one for the Nantucket Lightship Area and are one for Closed Area I over all scallop possession limit values. Multiplied by the controlled access trip length (or tradeoff), the total number of controlled access DAS to allocate ranges from 64 to 84 DAS. Summing across areas, the number of trips to allocate ranges from 8 to 5 full-time trips, 3 to 2 part-time trips, and one occasional trip.

Unlike the initial procedure suggested by the PDT in a July 22, 2003 memo to the Council, the analysis in this section used simple rounding to derive the number of allocated trips, rather than rounding up. Some cases nonetheless would potentially allow landings for a particular area to exceed the TAC, by as much as 89 percent with a 15 DAS/22,500 lb. trip in Closed Area I. Partly this results from rounding up and partly from the final policy of allocating no less than one trip per area. With a 12 DAS/18,000 lb. tradeoff that the Council ultimately approved, the trip allocations could allow landings of 109 percent of the Hudson Canyon Area TAC, 152 percent of the Closed Area I TAC, and 133 percent of the Nantucket Lightship Area TAC, averaging 115 percent (weighted) over all controlled access areas.

Although there is a potential to exceed the TAC in some areas and years, overall the average would be 100 percent of the TAC, except for areas that could allow less than one trip per year, which were raised to one trip to allow any access. There are, as a result, implications for habitat effects (see Section 8.5.7.2.1.1 on the habitat impacts of area rotation and access), scallop fishing mortality (this section), and bycatch (to be addressed in Framework Adjustment 16/39). Except for scallop fishing mortality, the impacts on habitat and bycatch within the access areas will obviously increase as more of the scallop TAC is taken. Relative to scallop fishing mortality, taking more of the TAC actually better approaches optimum yield because the scallops in the controlled access areas are near or older than the point at which maximum yield is obtained.

On the other hand, calculations using a rounding-down process greatly reduced the yield to be obtained from the controlled access programs. With a 12 DAS/18,000 lb. tradeoff, only 63% of the aggregate TAC could be taken if a procedure of rounding down the number of trips were used. This value ranged from 58 to 86 percent of the aggregate TAC for trip lengths ranging from 8 to 15 DAS.

A reasonable over-allocation of trips is not as problematic as it may seem at face value, since even with a new policy regarding the use of DAS only in areas for which they have been allocated, not all limited access vessels will take trips to controlled access areas. Smaller vessels, sometimes with part-time or occasional permits might be unable to fish in the available controlled access areas, even with trading. At this time, vessels in NC are quite far from the nearest controlled access area – Hudson Canyon. Some vessels may travel far enough to make a trip, but other vessels may find it is not worthwhile to travel from NC to the Hudson Canyon Area for one trips and 18,000 lbs. of scallop meats. Vessels from Maine might be in a similar situation, although limited access vessels in Maine are known to travel seasonally to Cape Cod to fish in the South Channel.

At the same time, full-time vessels have more of an opportunity to use their controlled access trips, but although one-to-one exchanges will be allowed for vessels that fish in a preferred area, not all vessels will be able to take advantage of the opportunity. Vessels that do not exchange trips with other limited access scallop vessels will either have to travel to all the controlled access areas or similar to vessels that did not fish their full compliment of DAS, would simply not take trips to distant controlled access areas. In 2004, vessels not taking trips to Nantucket Lightship Area and Closed Area I is probably more likely for vessels in the Mid-Atlantic due to the fewer number of trips available than for the Hudson Canyon Area when New England vessels consider fishing there. On the other hand, the catch rates are expected to be higher in the Nantucket Lightship Area and Closed Area I than in the Hudson Canyon Area, which could reduce fishing costs and balance the effect of the differential trip allocations.

Two other factors make it less likely for the trip allocations to actually exceed the controlled access target TACs. First, very few vessels actually land the scallop possession limit. Most landings during the controlled access programs in 1999 – 2002 landed several hundred to a thousand pounds less than the scallop possession limit, mostly due to uncertainties due to scallop swelling and water uptake in the hold and the difficulty in measuring weights at sea without sophisticated equipment. Often captains stop fishing to ensure their landings do not exceed the possession limit and deliberately land a bit less than allowed. This could account for 5 to 10 percent of the potential overage. Second, although Amendment 10 includes a new provision for broken trips, it does not entirely remove the business risk associated with a controlled access trip which at a minimum will cost two DAS, even if no landings are made. As with past experience, some vessel captains may decide not to take some controlled access trips because of this risk.

The actual DAS fished are less than the controlled DAS allocated and this can be calculated by estimating the average trip length by dividing the scallop possession limit by the average LPUE from the projections. Since the projection LPUEs factor in steam time on regular, open area trips, the LPUEs were adjusted to account for the increasing amount of total steam time associated with shorter controlled access trips. Assuming that the average open area trip lasts 14 days (although trip length varies by season, a 14-day trip is fairly customary in previous years) and the steam time to a controlled access area takes 36 hours to the Hudson Canyon Area and Closed Area I, 72 hours to Closed Area II, and 24 hours to the Nantucket Lightship Area, the average LPUE would vary between 2,230 lbs to 2,471 lbs. for the Hudson Canyon Area. Table 173 shows how the LPUE would vary for the other controlled access areas.

Using these average LPUE estimates, the average trip length was calculated and the number of DAS actually fished were derived from these estimates. With a 12 DAS/18,000 lb. tradeoff, full-time vessels will be allocated 84 DAS, but only fish 50.1 DAS if the vessel took all seven trips to the areas allocated. Exchanging trips may alter this value for an individual vessel (Nantucket Lightship Area is expected to have the highest LPUEs, the shortest trips, and therefore the least cost, for example), but over the entire fleet, the averages should occur anyway when averaged over the entire fleet. For full-time vessels, the expected DAS fished varies from 41.1 to 50.1 over controlled access tradeoffs ranging from 8 to 15 DAS.

Part-time vessel allocated 24 DAS are expected to fish only 14.3 DAS on average and occasional vessels allocated 12 DAS would be expected to fish for 8.4 DAS on average. It was not possible to factor in differences in fishing capacity with permit category or gear type, but the percent of days fished by vessels with lower crew limits[74] or different gear is a small fraction of the total.

As a result of the tradeoff and DAS allocations, the expected number of DAS fished from the allocations range from 10,721 to 13,533 DAS. With a 12 DAS/18,000 lb. tradeoff, the expected number of DAS fished[75] is 13,533 in 2004 (Table 173), 15,491 in 2005 (Table 174), 8,393 in 2006 (Table 175), and 6,860 in 2007 (Table 176). Thus the total DAS use combined for open and controlled access areas is 25,608 DAS in 2004, 27,104 in 2005, and 27,312 in 2006.

Thus, the total DAS use is about 10 to 20 percent lower than the 30,050 DAS used during the 2002 fishing year. Due to the area-specific DAS allocation system in this amendment, however, a much greater share of the total DAS (50-60 percent vs. 10 percent) of the DAS allocations will be used while fishing in the controlled access areas, where scallops are more abundant , catch rates are correspondingly higher and as a result the amount of bottom contact time is drastically reduced.

Although controlled access DAS allocations and their effects were calculated for 2005, 2006, and 2007, they follow the same general pattern and the calculations are shown in Table 174 to Table 176below.

[74] Vessels with small dredge permits are authorized to carry no more than 5 crew members, which implies a different shucking capacity per DAS.
[75] Includes time steaming to and from port.

Table 173. Trip and DAS allocations in 2004 with controlled access trip lengths ranging from 8 to 15 DAS.

DAS charge Scallop possession limit	8 12,000	9 13,500	10 15,000	11 16,500	12 18,000	13 19,500	14 21,000	15 22,500
Trip length adjusted LPUE								
Hudson Canyon Area	2,230	2,288	2,333	2,371	2,402	2,428	2,451	2,471
Closed Area I	2,074	2,127	2,170	2,204	2,233	2,258	2,279	2,297
Nantucket Lightship Area	2,850	2,895	2,931	2,961	2,985	3,006	3,024	3,040
Closed Area II	2,121	2,262	2,375	2,468	2,545	2,610	2,666	2,714
Maximum trips allocated								
Hudson Canyon Area	5	5	4	4	4	3	3	3
Closed Area I	1	1	1	1	1	1	1	1
Nantucket Lightship Area	2	2	2	2	2	1	1	1
Closed Area II	0	0	0	0	0	0	0	0
Maximum days allocated and charged								
Hudson Canyon Area	40	45	40	44	48	39	42	45
Closed Area I	8	9	10	11	12	13	14	15
Nantucket Lightship Area	16	18	20	22	24	13	14	15
Closed Area II	0	0	0	0	0	0	0	0
Controlled access days	64	72	70	77	84	65	70	75
Maximum controlled access trips taken								
Full-time	8	8	7	7	7	5	5	5
Part-time	3	3	2	2	2	2	2	2
Occasional	1	1	1	1	1	1	1	1
Potential percent of TAC landed								
Hudson Canyon Area	91.8%	103.3%	90.9%	100.0%	109.1%	90.2%	97.1%	104.1%
Closed Area I	101.0%	113.6%	126.3%	138.9%	151.5%	164.2%	176.8%	189.4%
Nantucket Lightship Area	88.5%	99.5%	110.6%	121.7%	132.7%	72.3%	77.8%	83.4%
Closed Area II								
Combined	88.5%	99.5%	95.9%	105.5%	115.1%	90.1%	97.1%	104.0%
Average days used per trip and annual day-at-sea tradeoff per full-time vessel								
Hudson Canyon Area	5.4	5.9	6.4	7.0	7.5	8.0	8.6	9.1
Closed Area I	5.8	6.3	6.9	7.5	8.1	8.6	9.2	9.8
Nantucket Lightship Area	4.2	4.7	5.1	5.6	6.0	6.5	6.9	7.4
Closed Area II								
Days charged, but not used (all allocated trips)	22.9	26.8	27.1	30.5	33.9	25.8	28.1	30.5
Total expected DAS use								
Hudson Canyon Area	7,330	8,041	6,946	7,520	8,098	6,586	7,027	7,470
Closed Area I	1,577	1,729	1,868	2,022	2,177	2,361	2,519	2,678
Nantucket Lightship Area	2,295	2,542	2,765	3,011	3,258	1,773	1,899	2,024
Closed Area II	-	-	-	-	-	-	-	-
Total DAS used	11,202	12,312	11,579	12,554	13,533	10,721	11,445	12,171
Full time — **Area specific DAS allocations**								
Hudson Canyon Area	40	45	40	44	48	39	42	45
Closed Area I	8	9	10	11	12	13	14	15
Nantucket Lightship Area	16	18	20	22	24	13	14	15
Closed Area II	-	-	-	-	-	-	-	-
Total controlled access DAS allocated	64	72	70	77	84	65	70	75
Days charged, but not used	22.9	26.8	27.1	30.5	33.9	25.8	28.1	30.5
DAS fished	41.1	45.2	42.9	46.5	50.1	39.2	41.9	44.5
Part time — **Area specific DAS allocations**								
Hudson Canyon Area	24	27	20	22	24	26	28	30
Closed Area I	8	9	10	11	12	13	14	15
Nantucket Lightship Area	16	18	20	22	24	13	14	15
Closed Area II	-	-	-	-	-	-	-	-
Total controlled access DAS allocated	24	27	20	22	24	26	28	30
Days charged, but not used	8.6	10.1	7.8	8.7	9.7	10.3	11.3	12.2
DAS fished	15.4	16.9	12.2	13.3	14.3	15.7	16.7	17.8

Table 174. Trip and DAS allocations in 2005 with controlled access trip lengths ranging from 8 to 15 DAS.

DAS charge / Scallop possession limit	8 / 12,000	9 / 13,500	10 / 15,000	11 / 16,500	12 / 18,000	13 / 19,500	14 / 21,000	15 / 22,500
Trip length adjusted LPUE								
Hudson Canyon Area	1,775	1,821	1,857	1,887	1,912	1,933	1,951	1,967
Closed Area I	1,514	1,553	1,584	1,610	1,631	1,649	1,664	1,677
Nantucket Lightship Area	2,026	2,058	2,084	2,105	2,122	2,137	2,150	2,161
Closed Area II	2,062	2,199	2,309	2,399	2,474	2,538	2,592	2,639
Maximum trips allocated								
Hudson Canyon Area	4	4	3	3	3	3	2	2
Closed Area I	0	0	0	0	0	0	0	0
Nantucket Lightship Area	0	0	0	0	0	0	0	0
Closed Area II	6	5	5	4	4	4	3	3
Maximum days allocated and charged								
Hudson Canyon Area	32	36	30	33	36	39	28	30
Closed Area I	0	0	0	0	0	0	0	0
Nantucket Lightship Area	0	0	0	0	0	0	0	0
Closed Area II	48	45	50	44	48	52	42	45
Controlled access days	80	81	80	77	84	91	70	75
Maximum controlled access trips taken								
Full-time	10	9	8	7	7	7	5	5
Part-time	4	3	3	2	2	2	2	2
Occasional	1	1	1	1	1	1	1	1
Potential percent of TAC landed								
Hudson Canyon Area	95.9%	105.3%	90.0%	95.9%	104.6%	113.3%	84.1%	90.1%
Closed Area I								
Nantucket Lightship Area								
Closed Area II	101.8%	94.8%	105.4%	91.9%	100.2%	108.6%	89.2%	95.6%
Combined	95.4%	96.0%	95.2%	90.8%	99.1%	107.4%	83.6%	89.5%
Average days used per trip and annual day-at-sea tradeoff per full-time vessel								
Hudson Canyon Area	6.8	7.4	8.1	8.7	9.4	10.1	10.8	11.4
Closed Area I								
Nantucket Lightship Area								
Closed Area II	5.8	6.1	6.5	6.9	7.3	7.7	8.1	8.5
Days charged, but not used (all allocated trips)	18.0	20.7	23.3	23.3	26.7	30.0	24.2	26.5
Total expected DAS use								
Hudson Canyon Area	7,384	8,046	6,602	7,086	7,630	8,176	5,886	6,256
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	9,537	8,328	8,850	7,431	7,861	8,303	6,645	6,993
Total DAS used	16,920	16,374	15,452	14,517	15,491	16,479	12,531	13,249
Full time — **Area specific DAS allocations**								
Hudson Canyon Area	32	36	30	33	36	39	28	30
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	48	45	50	44	48	52	42	45
Total controlled access DAS allocated	80	81	80	77	84	91	70	75
Days charged, but not used	18.0	20.7	23.3	23.3	26.7	30.0	24.2	26.5
DAS fished	62.0	60.3	56.7	53.7	57.3	61.0	45.8	48.5
Part time — **Area specific DAS allocations**								
Hudson Canyon Area	32	27	30	22	24	26	28	30
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	32	27	30	22	24	26	28	30
Total controlled access DAS allocated	32	27	30	22	24	26	28	30
Days charged, but not used	7.2	6.9	8.7	6.6	7.6	8.6	9.7	10.6
DAS fished	24.8	20.1	21.3	15.4	16.4	17.4	18.3	19.4

Table 175. Trip and DAS allocations in 2006 with controlled access trip lengths ranging from 8 to 15 DAS.

DAS charge Scallop possession limit	8 12,000	9 13,500	10 15,000	11 16,500	12 18,000	13 19,500	14 21,000	15 22,500
Trip length adjusted LPUE								
Hudson Canyon Area	1,414	1,450	1,479	1,503	1,523	1,540	1,554	1,566
Closed Area I	1,653	1,695	1,729	1,757	1,780	1,799	1,816	1,831
Nantucket Lightship Area	2,144	2,178	2,205	2,227	2,246	2,262	2,275	2,287
Closed Area II	1,927	2,055	2,158	2,242	2,312	2,371	2,422	2,466
Maximum trips allocated								
Hudson Canyon Area	0	0	0	0	0	0	0	0
Closed Area I	0	0	0	0	0	0	0	0
Nantucket Lightship Area	0	0	0	0	0	0	0	0
Closed Area II	5	5	4	4	4	3	3	3
Maximum days allocated and charged								
Hudson Canyon Area	0	0	0	0	0	0	0	0
Closed Area I	0	0	0	0	0	0	0	0
Nantucket Lightship Area	0	0	0	0	0	0	0	0
Closed Area II	40	45	40	44	48	39	42	45
Controlled access days	40	45	40	44	48	39	42	45
Maximum controlled access trips taken								
Full-time	5	5	4	4	4	3	3	3
Part-time	2	2	1	1	1	1	1	1
Occasional	1	1	1	1	1	1	1	1
Potential percent of TAC landed								
Hudson Canyon Area								
Closed Area I								
Nantucket Lightship Area								
Closed Area II	88.5%	99.5%	87.2%	95.9%	104.7%	85.8%	92.4%	99.0%
Combined	88.5%	99.5%	87.2%	95.9%	104.7%	85.8%	92.4%	99.0%
Average days used per trip and annual day-at-sea tradeoff per full-time vessel								
Hudson Canyon Area								
Closed Area I								
Nantucket Lightship Area								
Closed Area II	6.2	6.6	7.0	7.4	7.8	8.2	8.7	9.1
Days charged, but not used (all allocated trips)	8.9	12.2	12.2	14.6	16.9	14.3	16.0	17.6
Total expected DAS use								
Hudson Canyon Area	-	-	-	-	-	-	-	-
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	8,515	8,980	7,494	7,934	8,393	6,711	7,075	7,445
Total DAS used	8,515	8,980	7,494	7,934	8,393	6,711	7,075	7,445
Full time — **Area specific DAS allocations**								
Hudson Canyon Area	-	-	-	-	-	-	-	-
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	40	45	40	44	48	39	42	45
Total controlled access DAS allocated	40	45	40	44	48	39	42	45
Days charged, but not used	8.9	12.2	12.2	14.6	16.9	14.3	16.0	17.6
DAS fished	31.1	32.8	27.8	29.4	31.1	24.7	26.0	27.4
Part time — **Area specific DAS allocations**								
Hudson Canyon Area	-	-	-	-	-	-	-	-
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	16	18	10	11	12	13	14	15
Total controlled access DAS allocated	16	18	10	11	12	13	14	15
Days charged, but not used	3.5	4.9	3.0	3.6	4.2	4.8	5.3	5.9
DAS fished	12.5	13.1	7.0	7.4	7.8	8.2	8.7	9.1

Table 176. Trip and DAS allocations in 2006 with controlled access trip lengths ranging from 8 to 15 DAS.

DAS charge Scallop possession limit	8 12,000	9 13,500	10 15,000	11 16,500	12 18,000	13 19,500	14 21,000	15 22,500
Trip length adjusted LPUE								
Hudson Canyon Area	1,063	1,090	1,112	1,130	1,145	1,157	1,168	1,177
Closed Area I	1,820	1,867	1,904	1,935	1,960	1,982	2,000	2,016
Nantucket Lightship Area	2,281	2,318	2,347	2,370	2,390	2,407	2,421	2,433
Closed Area II	1,784	1,903	1,998	2,076	2,141	2,196	2,243	2,284
Maximum trips allocated								
Hudson Canyon Area	0	0	0	0	0	0	0	0
Closed Area I	0	0	0	0	0	0	0	0
Nantucket Lightship Area	0	0	0	0	0	0	0	0
Closed Area II	5	4	4	4	3	3	3	3
Maximum days allocated and charged								
Hudson Canyon Area	0	0	0	0	0	0	0	0
Closed Area I	0	0	0	0	0	0	0	0
Nantucket Lightship Area	0	0	0	0	0	0	0	0
Closed Area II	40	36	40	44	36	39	42	45
Controlled access days	40	36	40	44	36	39	42	45
Maximum controlled access trips taken								
Full-time	5	4	4	4	3	3	3	3
Part-time	2	1	1	1	1	1	1	1
Occasional	1	1	1	1	1	1	1	1
Potential percent of TAC landed								
Hudson Canyon Area								
Closed Area I								
Nantucket Lightship Area								
Closed Area II	95.5%	84.7%	94.2%	103.6%	85.5%	92.7%	99.8%	106.9%
Combined	95.5%	84.7%	94.2%	103.6%	85.5%	92.7%	99.8%	106.9%
Average days used per trip and annual day-at-sea tradeoff per full-time vessel								
Hudson Canyon Area								
Closed Area I								
Nantucket Lightship Area								
Closed Area II	6.7	7.1	7.5	7.9	8.4	8.9	9.4	9.9
Days charged, but not used (all allocated trips)	6.4	7.6	10.0	12.2	10.8	12.4	13.9	15.4
Total expected DAS use								
Hudson Canyon Area	-	-	-	-	-	-	-	-
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	9,194	7,647	8,092	8,567	6,860	7,246	7,640	8,039
Total DAS used	9,194	7,647	8,092	8,567	6,860	7,246	7,640	8,039
Full time — **Area specific DAS allocations**								
Hudson Canyon Area	-	-	-	-	-	-	-	-
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	40	36	40	44	36	39	42	45
Total controlled access DAS allocated	40	36	40	44	36	39	42	45
Days charged, but not used	6.4	7.6	10.0	12.2	10.8	12.4	13.9	15.4
DAS fished	33.6	28.4	30.0	31.8	25.2	26.6	28.1	29.6
Part time — **Area specific DAS allocations**								
Hudson Canyon Area	-	-	-	-	-	-	-	-
Closed Area I	-	-	-	-	-	-	-	-
Nantucket Lightship Area	-	-	-	-	-	-	-	-
Closed Area II	16	9	10	11	12	13	14	15
Total controlled access DAS allocated	16	9	10	11	12	13	14	15
Days charged, but not used	2.5	1.9	2.5	3.1	3.6	4.1	4.6	5.1
DAS fished	13.5	7.1	7.5	7.9	8.4	8.9	9.4	9.9

8.2.4 Observer Sampling Frequency Funded via TAC and DAS Set-aside

Section 5.1.8.1 provides a one-percent set aside from the controlled access area TACs and from the open area target DAS use to defray the cost of mandatory observers on scallop vessels. This program spreads the cost of observer over all limited access vessels that use DAS to fish for scallops and that fish in the controlled access areas. Without this procedure or government funding, the entire cost of carrying the observer would be borne by that vessel and some vessels may, as a result, shoulder an undue burden for the observer program.

Under the system that applies for controlled access areas, a vessel carrying an observer will be allowed to land more than the 18,000 lb. scallop possession limit on an observed trip. For open fishing areas, a vessel carrying a mandatory observer would be granted a DAS adjustment or rebate, using a constant factor per observer day. The Regional Administrator may reduce the number of DAS charged for an observed trip, or may increase the vessel's annual DAS allocation to allow the vessel to fish more DAS in the year than it would have without carrying observers.

For both areas, increasing the allowance to compensate the vessel will reduce the number of trips and the proportion of observed trips. The medium of exchange between these two systems is different and as a result the effects on the number and proportion of observed trips varies.

8.2.4.1 Controlled access areas

With an allowance to land more scallops per trip when an observer is onboard, the results vary because the vessel must catch and process the extra allowance while the observer is onboard, which incurs additional observer cost. Differences in LPUE also effect trip length to catch 18,000 lbs. of scallops and this changes the trips' observer cost, since vessels are charged per DAS on observed trips. How quickly the vessel catches and processes these extra scallops depends on the catch rate and shucking capacity (LPUE).

Table 177 to Table 180 estimate the proportion of trips that would be observed without exceeding the TAC set aside for the 2004 to 2007 fishing years. All analyses assume that access to the Georges Bank closed areas will occur and that the TACs and trip allocations will be what are estimated in this document. The results vary because different areas are open to controlled access scallop fishing in different years. Thus, the estimated catch rates differ by area and over time within an area. Also estimated is the amount of revenue that the extra landings would generate, by applying the daily observer landings allowance to the trip length and multiplying by the predicted price per pound for each year. This is a gross revenue calculation and does not account for other costs to the vessel and crew, associated with the time and effort catching and processing the observer allowance. These costs include all variable expenses associated with fishing, including extra food, ice, and fuel, which are customarily paid out of the crew share.

Results were calculated for observer allowances of 200, 400, 600, and 1,000 lbs./day. A 200 lbs./day allowance would generate ex-vessel revenue of $700 to 800 per DAS, approximately the amount charged to the vessel carrying an observer. Ex-vessel revenues increase in proportion to the allowance, but net revenues would increase less because of the added variable fishing costs to catch and process the observer allowance.

The number and proportion of trips also do not change proportionally with the observer allowance for the same reason. A minimum estimate assumes that limited access scallop vessels use all available controlled access area DAS and trips during the fishing year. Also it assumes that all vessels with observers catch and land the entire observer compensation allowance. A more probably result is that the limited access vessels take 75 percent of their controlled access area DAS and trips, and vessels with observers catch and land 50 percent of the observer compensation allowance, on average.

Although we have no experience and track record with area-specific DAS allocations (previously, vessels could use controlled access area allocations to fish in regular, open fishing areas without being assessed the DAS tradeoff), it is unlikely that limited access vessels will utilize all the controlled access area trips. First, vessels that have historically fished few of their allocated days will be unlikely to use much of their controlled access area allocations. Second, even with one-to-one exchanges, it is unlikely that all vessels will be able to utilize all controlled access area trips, because they might not be able to fish in a distant area or find someone willing to exchange trips.

Our experience with the observer compensation allowance is that many vessels do not take advantage of the extra landings allowance to defray the observer cost. Some vessels don't even land the scallop possession limit, so the extra allowance doesn't offer the vessel something more that it already has. In any case, during 2002 and 2003, little if any of the TAC set-aside for the Hudson Canyon and VA/NC Areas had been used.

In 2004 (Table 177), a 400 lbs./day trip allowance would fund observers on a minimum of 93 trips, or 4.9% of the total. Decreasing the observer compensation allowance to 200 lbs./day would increase the number of observed trips to 199 trips, or 10.5%. Compared to observer programs to monitor bycatch with relatively good precision, these sampling frequencies are a little low. If, however, the controlled access area allocation use declines to 75% of the total, and on average vessels land 200 lbs./day on observed trips against the TAC set aside (this is equivalent to a 400 lbs./day observer compensation allowance), the number of observed trips increases to 199 (essentially the same as if vessel had landed 100% of a 200 lbs./day observer compensation allowance) but the proportion of observed trips increases to 14%.

Although the results for each year vary, the trends in revenue generated and sampling frequency are fairly constant. The amount of trips sampled varies due to differences in the TACs for controlled access areas open at the time. Also, the results for no access (i.e. only the Hudson Canyon Area would be subject to a TAC and controlled access) are pretty consistent with those in Table 177 and Table 178.

Using the "probable" scenario for 2004 as an example, a 1,000 lbs./day observer compensation allowance would generate about $3,800 per day in income to pay an observer cost around $800 – 1,000 per day and allow sampling on about 5% of the controlled access area trips taken. A 600 lbs./day observer compensation allowance would generate about $2,300 per day and allow sampling on about 9% of the controlled access area trips taken. A 400 lbs./day observer compensation allowance would generate about $1,500 per day and allow sampling on about 14% of the controlled access area trips taken. A 600 lbs./day observer compensation allowance would generate about $800 per day and allow sampling on about 29% of the controlled access area trips taken.

While a 200 lbs./day allowance might not compensate the vessel and crew for carrying an observer, after deducting variable fishing costs, a 400 lbs./day might accomplish this objective and still allow sampling of about 15% of trips taken which often is sufficient to characterize bycatch on a resource-wide or stock-wide basis. Sampling rates higher than 15% might be needed to characterize an area-specific catch of a finfish species to compare with a hard TAC.

Table 177. Number and proportion of observed trips in controlled access areas in **2004** vs. daily scallop possession limit allowance. The "probable" estimate assumes that 75% of allocated trips are taken during the fishing year and that 50% of vessels carrying observers land more than the 18,000 lb. scallop possession limit to defray the costs of the observer.

Landings allowance per observer day	Ex-vessel revenue per observer day	Minimum estimate of observed trips in controlled access areas		"Probable" estimate of observed trips in controlled access areas	
		Trips	Percent	Trips	Percent
200	$ 768	199	10.5%	414	29.2%
400	$ 1,536	93	4.9%	199	14.0%
600	$ 2,304	58	3.1%	128	9.0%
1,000	$ 3,839	31	1.6%	72	5.1%

Table 178. Number and proportion of observed trips in controlled access areas in **2005** vs. daily scallop possession limit allowance. The "probable" estimate assumes that 75% of allocated trips are taken during the fishing year and that 50% of vessels carrying observers land more than the 18,000 lb. scallop possession limit to defray the costs of the observer.

Landings allowance per observer day	Ex-vessel revenue per observer day	Minimum estimate of observed trips in controlled access areas		"Probable" estimate of observed trips in controlled access areas	
		Trips	Percent	Trips	Percent
200	$ 719	202	10.7%	421	29.7%
400	$ 1,438	93	4.9%	202	14.2%
600	$ 2,157	58	3.1%	129	9.1%
1,000	$ 3,596	30	1.6%	72	5.1%

Table 179. Number and proportion of observed trips in controlled access areas in **2006** vs. daily scallop possession limit allowance. The "probable" estimate assumes that 75% of allocated trips are taken during the fishing year and that 50% of vessels carrying observers land more than the 18,000 lb. scallop possession limit to defray the costs of the observer.

Landings allowance per observer day	Ex-vessel revenue per observer day	Minimum estimate of observed trips in controlled access areas		"Probable" estimate of observed trips in controlled access areas	
		Trips	Percent	Trips	Percent
200	$ 732	113	10.5%	235	29.1%
400	$ 1,464	52	4.9%	113	14.0%
600	$ 2,196	32	3.0%	72	9.0%
1,000	$ 3,660	17	1.6%	40	5.0%

Table 180. Number and proportion of observed trips in controlled access areas in **2007** vs. daily scallop possession limit allowance. The "probable" estimate assumes that 75% of allocated trips are taken during the fishing year and that 50% of vessels carrying observers land more than the 18,000 lb. scallop possession limit to defray the costs of the observer.

Landings allowance per observer day	Ex-vessel revenue per observer day	Minimum estimate of observed trips in controlled access areas		"Probable" estimate of observed trips in controlled access areas	
		Trips	Percent	Trips	Percent
200	$ 771	96	11.8%	201	32.9%
400	$ 1,542	44	5.4%	96	15.7%
600	$ 2,312	27	3.4%	62	10.1%
1,000	$ 3,854	14	1.8%	34	5.6%

8.2.4.2 Regular, open scallop fishing areas

Unlike the analysis for controlled access areas, the proportion of trips observed in regular, open fishing areas does not vary with catch rates or total DAS allocations, since the changes in LPUE affect observed and unobserved trips equally. All analysis assumes that in the absence of a scallop possession limit, the average trip length is the historical average around 14 DAS. The factor that changes with LPUE over time is the DAS equivalency with the scallop possession limit allowances in the controlled access areas. With lower LPUE in open areas, particularly when the status quo overfishing definition is applied without access, it takes longer to catch and process 200, 400, or 600 lbs./day.

Several DAS adjustment factors were applied in the analysis to determine the effect of changing the DAS adjustment factor on sampling frequency, i.e. the proportion of observed trips to total trips taken. DAS adjustment factors were chosen to be equivalent to 50, 100, 200, 400, and 600 lbs./day in 2004 (Table 181). The ex-vessel revenue generated by the DAS adjustments is in 2004 equivalent to the revenue per day for vessels fishing in the controlled access areas. For example, a DAS adjustment factor of 0.13-0.14 per DAS generates about $750 of revenue per day, assuming that the vessel uses the extra DAS to fish for scallops. That adjustment factor, dividing the DAS rebate for a 14 day trip into the DAS set asides would allow the program to sample 6.9 to 7.8% of all trips in the open fishing areas. The sampling frequency is relatively constant across years, because the total number of DAS used and the DAS set aside are proportional by set policy (i.e. a 1% set aside).

Increasing the DAS adjustment factor to 0.26 to 0.29, equivalent to 400 lbs./day in 2004, generates about $1,500 per day of ex-vessel revenue to compensate the vessels, but allows sampling on only 3.5 to 3.9 percent of trips. As the LPUE declines (Open area LPUE is projected to decline with the status quo overfishing definition, even with access. Without access, open area LPUE declines more quickly than with access.), the sampling frequency remains nearly constant, but the revenue generated per DAS also declines, decreasing compensation to the vessel for carrying an observer.

The DAS adjustment factor is a constant value that compensates the vessel for carrying an observer. With a DAS adjustment factor of 0.14, a 10-day trip would be charged 8.6 DAS, for example. Alternatively, the vessel paying for 10 observer days would be credited with 1.4 DAS on its annual DAS allocation. A vessel taking a 14-day observed trip would be credited with 1.96 DAS.

While the analysis for the open area DAS set aside program indicates that a slightly lower sampling frequency would be possible than under the controlled access area TAC set-aside, this may not be as critical if it isn't as important to sample finfish bycatch as accurately in the open areas as it is in the controlled access areas.

Table 181. Estimated sampling frequency (proportion of observed trips) vs. DAS adjustment factor for vessels carrying an observer on open area trips.

Scallop catch equivalent	50	100	200	400	600
With Georges Bank access					
DAS Adjustment Factor	0.03	0.06	0.13	0.26	0.39
Sampling frequency	31.0%	15.5%	7.8%	3.9%	2.6%
Ex-vessel revenue (2004-2007 average)	$187	$374	$747	$1,495	$2,242
No Georges Bank access					
DAS Adjustment Factor	0.04	0.07	0.14	0.29	0.43
Sampling frequency	27.6%	13.8%	6.9%	3.5%	2.3%
Ex-vessel revenue (2004-2007 average)	$192	$384	$769	$1,538	$2,307

8.2.5 Rotation management areas: "Elephant Trunk Area"

New data that became available since the publication of the DSEIS led the Council to re-analyze and re-evaluate the proposed rotation management area closures. In particular, SMAST had begun to survey the resource in the Mid-Atlantic during 2003 and scallop density estimates for stations that appeared visually to be dominated by 'seed' scallops could be plotted. The annual R/V Albatross scallop survey had also just completed the Mid-Atlantic leg of the resource survey, and although the data had not yet been processed, survey personal helped to identify where they had observed high abundances of small scallops. Discard ratios on observed commercial scallop trips during 2003 were also available, and could help to better identify where small scallops appeared based on the locations of tows with high discard-to-kept scallop ratios.

These preliminary data were combined with detailed size-frequency distributions for small scallops in the 2001 and 2002 annual resource survey. The smallest scallops observed in the survey during 2001 would be age 3 in the 2003 survey, and likewise the smallest scallops and the next larger year class observed in the 2002 survey would be age 2 and 3 in the 2003 survey.

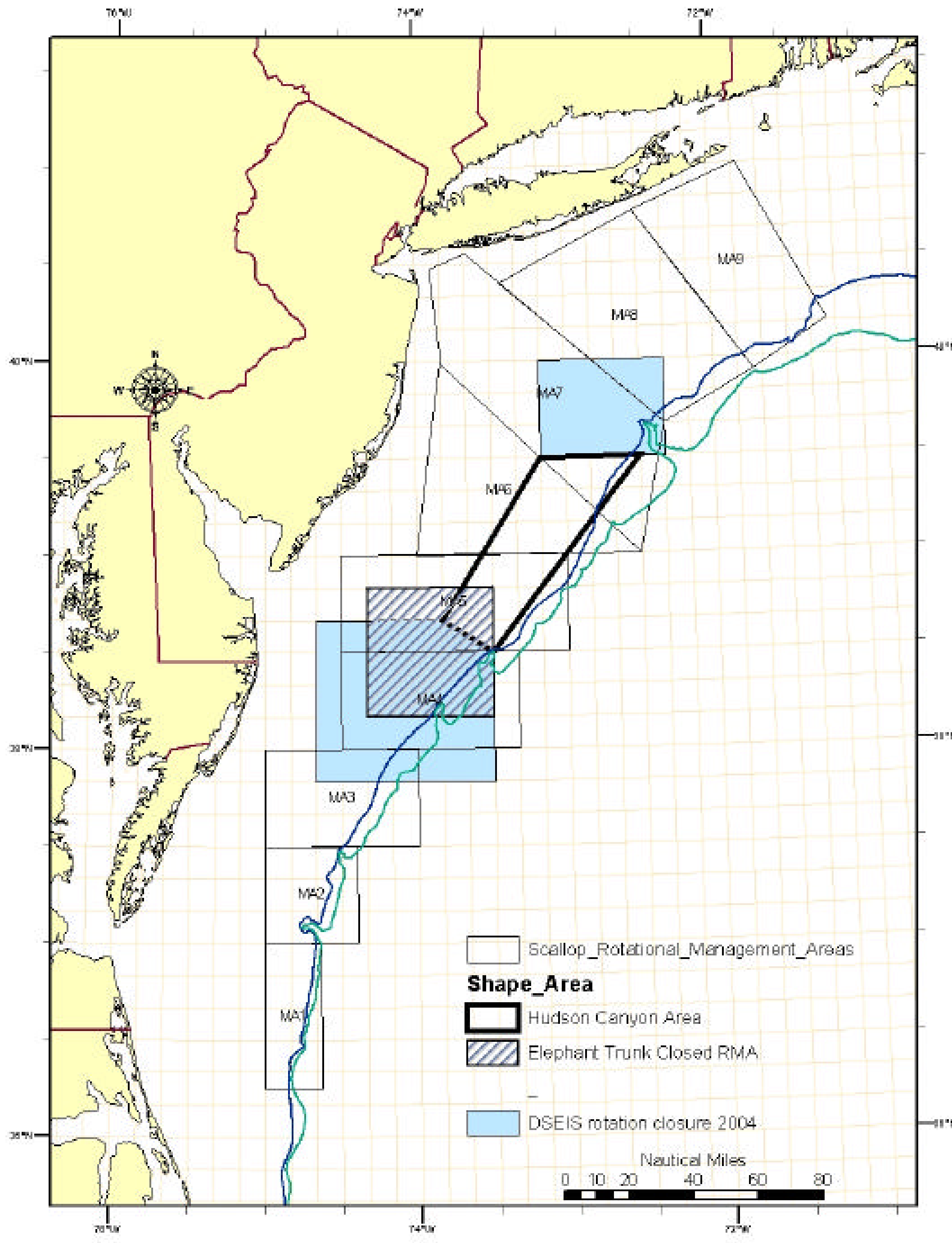
These data and more detailed analysis caused the Council to re-examine the proposed rotation area management closures in the DSEIS. The new rotation closure (Map 48) is a slight modification of the southern Mid-Atlantic closure taken out to public hearing, which better targets the distribution of small scallops that were present during the summer of 2003. Neither the SMAST video survey or the Mid-Atlantic leg of the Albatross survey indicated that the northern Mid-Atlantic closures would serve the purpose it was intended to serve and was no longer needed for area rotation. Similarly, the closure of the GB2 rotation area off of Cape Cod was intended to protect the abundant young scallops that had been first observed in the 2001 resource survey and originally considered for closure in Framework Adjustment 14 in 2001. The scallops that appeared then have been vulnerable to fishing for two years and that closure of this area is no longer needed. New data when available may spur the Council into taking action to implement a rotation management area closure on Georges Bank when new beds of small scallops are observed.

The SMAST data suggested that the rotation management area closure of a 3 x 5 ten-minute square block from 38°30' to 38°50' N longitude would be sufficient to encompass the distribution of small scallops observed by the video survey. The Albatross data from the 2002 survey and an analysis of 2003 small scallop discards, however, indicated that a southerly extension of 10' would be needed to protect abundant small scallops found further to the south. The PDT therefore also recommend consideration of a 4 x 5 ten-minute square block between 38°20' and 38°50' N latitude, although there were also beds of commercial-size scallops interspersed in this southerly extension. In the final analysis, the Council concluded that it would be best to protect the full range of these abundant small scallops to help address some of the conservation concerns over the Mid-Atlantic scallop resource.

The effects of this proposed closure on future scallop management, biology, and yield have been analyzed by folding the proposed closure into the final projections in Section 8.2.2.2. Because redefining the boundaries adaptively requires scallop distribution data that are not yet available for analysis, the projections assume that the substantial majority of the scallop resource in the Elephant Trunk Area are in the rotation management area known as MA4. The projections were modified to assume in all iterations that the MA4 rotation management area would close on March 1, 2004 and remain closed for a three-year period. Results for adaptive strategies to re-opening the Elephant Trunk Area may deviate from this three-year assumption and affect future benefits analyzed above.

Some concern was also raised before the Council took final action about the effects on finfish bycatch and sea turtle interactions, compared with the analysis in the DSEIS. For the proposed Mid-Atlantic closures, data do not exist at the scale needed to distinguish between the DSEIS closures and the final rotation closure. With respect to sea turtle interactions, rotation closures have a minimal impact on interactions with sea turtles, because the effort shift associated with meeting the overfishing definition mortality target is shifted in general throughout the resource. On the other hand, what will matter more is the implementation and timing of when the area re-opens to fishing, which will be an important consideration in the framework adjustment that will re-open the Elephant Trunk area to controlled access, probably in 2006, 2007, or 2008.

Habitat impacts of the new closure area are not terribly different from those analyzed in the DSEIS. Nonetheless, additional analysis of the final alternative with the closure, with rotation management, and with and without Georges Bank area access is presented in Section 8.2.2.2. As far as keeping the GB2 area open, incidental and bycatch of finfish species that inhabit the South Channel will be higher than if the area had closed under area rotation. These include yellowtail flounder and skates, in particular. Similarly, the GB2 area has more hard substrates and EFH designations than surrounding areas. Impacts on these valuable environmental components have been minimized by other means, including habitat closures in this amendment, and DAS controls coupled with crew limits that reduce bottom contact time.



Map 48. Visual comparison between the final "Elephant Trunk" Mid-Atlantic closed rotation area, the initial proposed closed rotation areas in the DSEIS, the controlled access Hudson Canyon Area, and the rotation management areas that were used in the biological projection analyses.

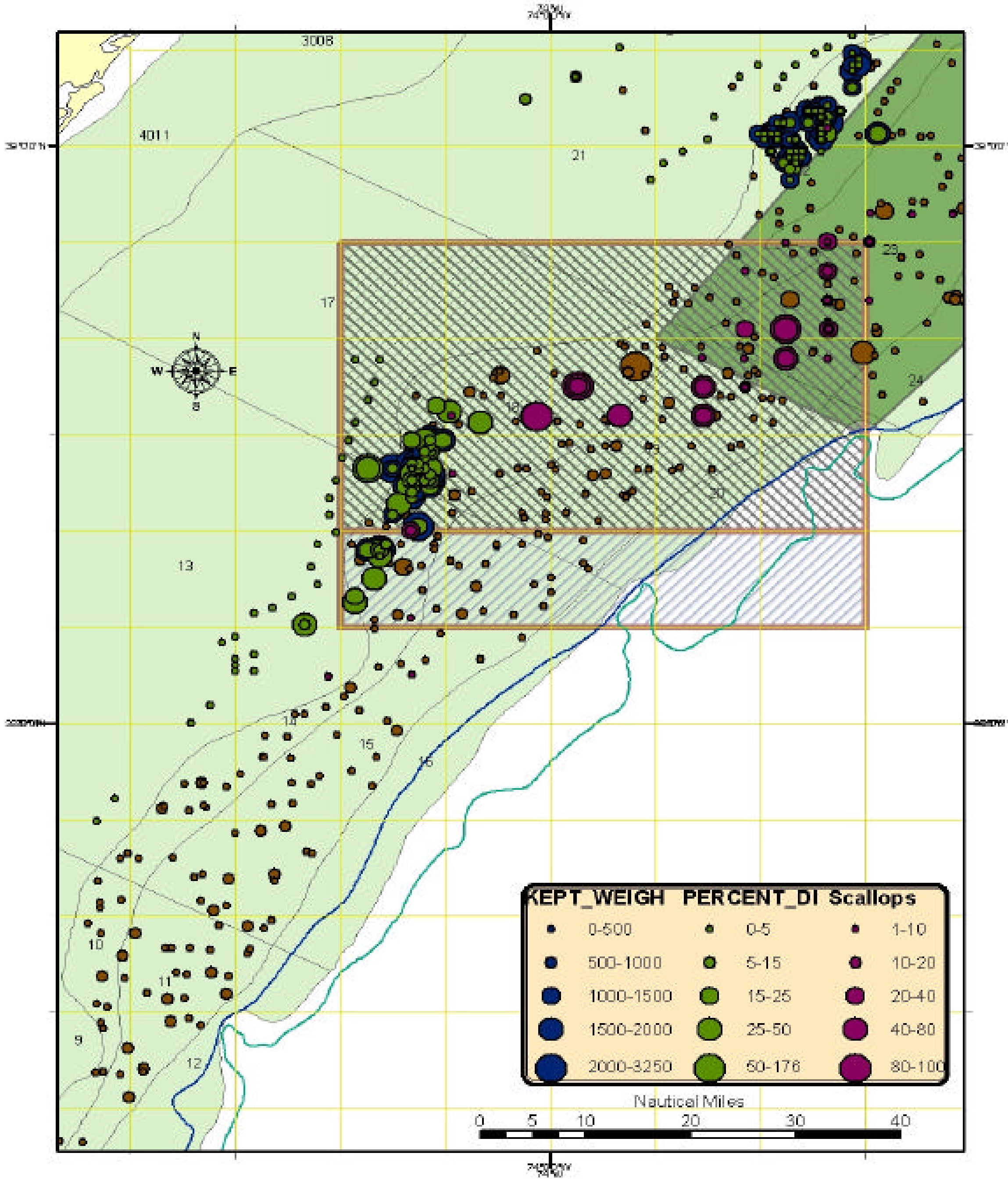
Plan Development Team re -analysis and review of proposed rotation management area closures based on 2003 conditions

The PDT recommended a reconfiguration of the proposed Mid-Atlantic rotation area management closure, south of the Hudson Canyon Area and the omission of the rotation area management closure north of the Hudson Canyon Area. Thus, unless other data come to light, there would be one instead of two closures in the Mid-Atlantic during 2004. The PDT did not do any further analysis on the proposed closure of GB2 in the South Channel, near Nantucket Island and Chatham.

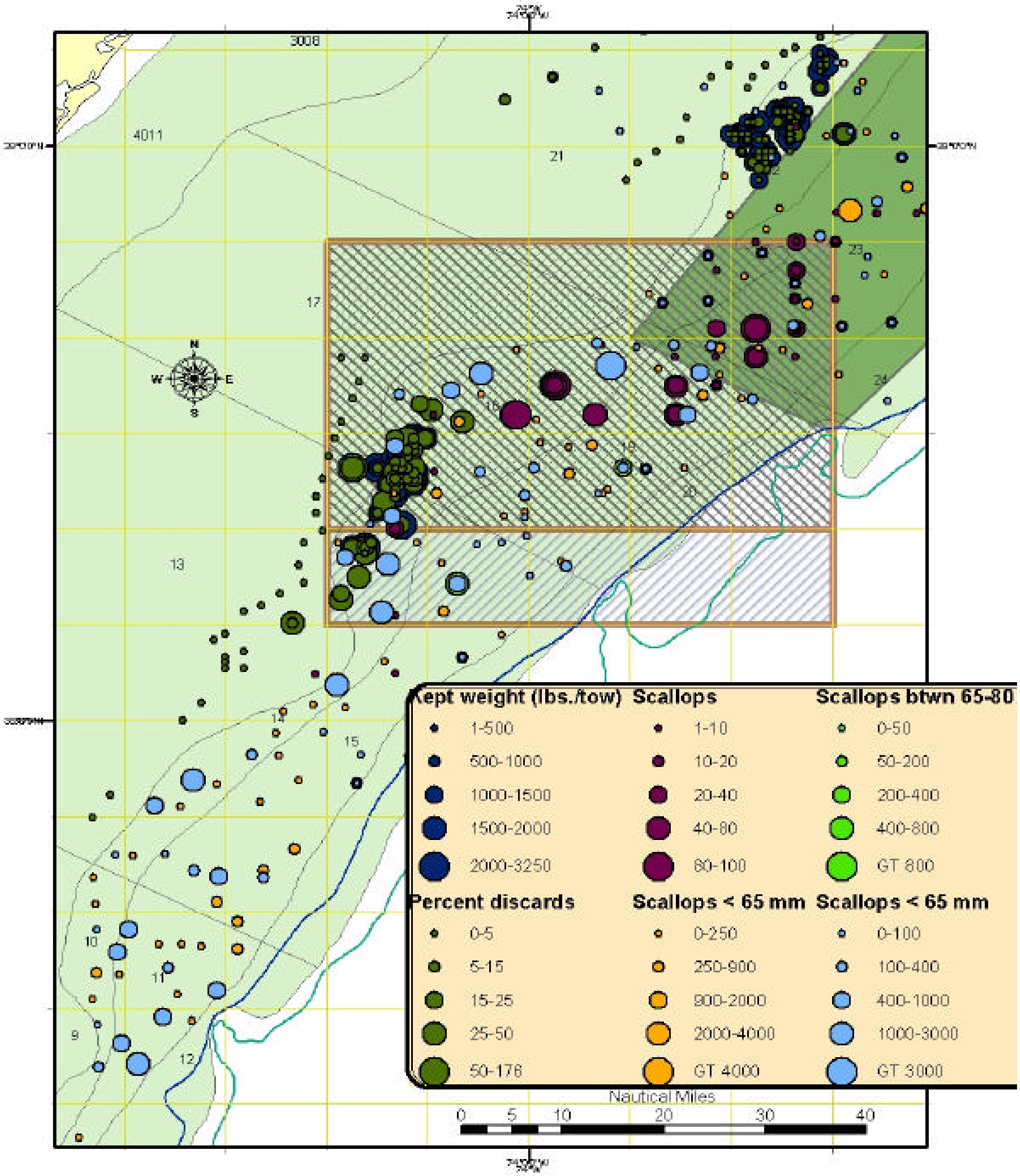
The newly configured Mid-Atlantic closure would overlap the SW corner of the Hudson Canyon Area and as such would re-close a part of the Hudson Canyon Area while it is still under controlled access. The area that the PDT is recommending for closure is a rectangle bounded by 34°10' N latitude, 74°20' W longitude on the SW and 38°50' N latitude, 73°30' W longitude on the NW. This block encompasses 15 ten-minute squares.

In addition, the PDT recommends that the Council consider closing the next set of ten-minute squares to the south, which would include small scallops observed in 2002 by the R/V Albatross scallop survey and in the 2003 sea sampling observer program as discards. This would change the SW corner of the closure area to 34°0' N latitude, 74°20' W longitude.

In 2003, the SMAST video survey encountered significant beds of small scallops from in the SW corner of the Hudson Canyon Area, extending outside the area to the SW (see purple stations in Map 49 and Map 50 below). The 2002 Albatross survey also observed these beds of small scallops, but also observed beds of small scallops yet further to the SW, into stratum 14 (see brown stations in the figures below). Validating this distribution of small scallops, the sea sampling observer program on scallop dredge boats also observed large amounts of small scallops, which commercial fishermen discarded (see distribution of blue and green circles, representing the kept weight and the percent of scallops discarded, respectively).



Map 49. Distribution of small scallops in the annual scallop survey during 1999-2002 (< 65 mm; brown circles); small scallops in the 2003 SMAST survey (no specific size identified; purple circles); and in the percent of discards (green) and kept scallops (blue) in sea sampled scallop dredge trips during 2003 (commercial cull)



Map 50. Distribution of small scallops in the annual scallop survey during 2001-2002 (< 65 mm; orange and light blue circles; 65-80 mm light green circles); small scallops in the 2003 SMAST survey (no specific size identified; purple circles); and in the percent of discards (green) and kept scallops (blue) in sea sampled scallop dredge trips during 2003 (commercial cull)

8.2.6 Effects of habitat and groundfish closures

The above comparative analysis was done without habitat closures. Under the proposed overfishing definition, the change in yield and day-at-sea allocations is in direct proportion to the amount of scallop grounds within the habitat closures for each rotation management area. Under the status quo overfishing definition, instead of determining the appropriate level of effort for exploitable areas, effort associated with the definition's annual fishing mortality target would be applied to remaining fishing areas. Over time, the higher fishing mortality in the open areas would affect the future scallop biomass and differ from the projections given above.

To calculate the quantitative effects of habitat closures with the status quo overfishing definition would require a re-stratification of the survey time series and a different biological projection for each habitat closure alternative. Given the complexity of that analysis and the number of alternatives currently under review, the analysis cannot be done at this time.

We can, however, describe the general effects of the habitat closures under the status quo overfishing definition. A complete projection analysis, re-stratifying the survey time series, will be conducted after the Council selects the proposed action for the final amendment.

The effects of habitat closures with the status quo overfishing definition would be similar to those experienced since the closure of the Georges Bank groundfish areas. Fishing mortality in open fishing areas would generally exceed F_{max} (see NEFMC 2000 and NMFS 2001), causing lower biomass levels, lower landings and revenue, lower average size, and lower daily catches. At the same time, the scallop biomass in the closed areas would increase and allow the plan to meet its biomass targets. If all the habitat closures are in the Georges Bank region, the associated fishing effort could shift to the Mid-Atlantic, raising fishing mortality rates there and increase the risk of an overfished condition for Mid-Atlantic sea scallops.

This outcome can be demonstrated by comparing the total Georges Bank scallop biomass (weight per survey tow) for the two overfishing definitions, assuming that there is no access to the Georges Bank groundfish closed areas (Figure 72 in the DSEIS). With no access, the average weight per tow would be between 10,000 and 12,000 g/tow, **most of the biomass occurring in the groundfish closed areas**. With the proposed overfishing definition, total Georges Bank scallop biomass with no access to the groundfish closed areas would increase to 18,000 g/tow (Figure 72 in the DSEIS), **the difference being the biomass of scallops in areas that are presently open to scallop fishing.**

The distribution of the habitat closures between scallop areas and the proportion of scallop biomass in the habitat closures would have varying indirect effects on scallop biology and management. Under the status quo overfishing definition, more habitat closures that cover a greater proportion of the scallop resource would concentrate the fishing effort into smaller areas, raising fishing mortality on available scallops and cause lower yield-per-recruit. It might require more rotation management area to protect small scallops and/or areas with small scallops would occur more frequently due to localized overexploitation. More habitat closures on Georges Bank and in the South Channel would compound the problem, putting greater fishing pressure on scallops found on the Mid-Atlantic shelf.

With the proposed overfishing definition, the annual fishing mortality targets would be adjusted such that the time averaged fishing mortality on available scallops would approximate F_{max}, thereby maximizing the yield from the scallops that remain available for fishing.

8.2.7 Gulf of Maine scallops

Amendment 10 does not propose area rotation for Gulf of Maine scallops because it is a minor part of the overall scallop resource and because there are various impediments to doing a comprehensive resource survey there. Information with which to begin an area rotation system in the Gulf of Maine is currently lacking and the benefits of doing so would be relatively small76.

Even though there is no formal assessment or survey of scallops in the Gulf of Maine, Amendment 10 will have effects on scallop fishing there. Vessels with a federal scallop permit or that fish in federal waters would still be subject to the regulations associated with this management plan, including crew limits, gear restrictions, area closures, and day-at-sea allocations. Amendment 10 proposes several combinations of area closures to protect essential fish habitat in the Gulf of Maine and the different day-at-sea allocations associated with the overfishing definition fishing mortality target would have an effect.

The direct effects on scallop fishing in the Gulf of Maine and on ports that derive landings from effected trips is analyzed in Section 8.8.4.1 . Closures may increase fishing mortality on scallops elsewhere in the Gulf of Maine under either overfishing definition, because a closure in an unsurveyed scallop area would not affect the fishing mortality target. Thus the displaced fishing effort may be used to fish in the remaining open areas, potentially reducing yield-per-recruit in addition to the yield loss directly caused by closing areas indefinitely to protect habitat from the effects of scallop fishing.

8.2.8 Effects of ring size on scallop size selection.

The use of a 4" (102 mm) ring sea scallop dredge is not new. In the 1970s, some mid-Atlantic scallopers used 4" rings to reduce the amount of surf clam shell retained by the dredges. In the Alaskan scallop fishery, the use of 4" rings without chaffing gear is required. Bourne (1965) evaluated the performance of a 4" ring dredge and concluded that larger ring dredges were more efficient at capturing large scallop than did smaller ring dredges. This phenomenon was also observed by DuPaul *et. al.* (1995) in evaluating a 3.5" ring dredge.

The present study was designed to evaluate the performance of a 4" ring dredge relative to a 3.5" ring dredge in the Georges Bank and Hudson Canyon Closed Areas during and after controlled openings for commercial harvests. Criteria for evaluation centered around: (1) the decrease in capture rates of small scallops that would be discarded if captured; (2) the change in dredge efficiency relative to the capture of larger scallops to be retained; (3) the change in the amount of invertebrate and other "trash" retained by the dredge; and (4) any changes in the capture of finfish bycatch.

Eight research trips were conducted aboard the commercial scallop vessel, F/V *Celtic* from the port of New Bedford, Massachusetts into the three Georges Bank Closed Areas and into the Hudson Canyon Closed Area. Three trips were conducted into Georges Bank Closed Area II (CAII) in July 2000, September 2000 and June 2001, two trips into Closed Area I (CAI) in October 2000, one trip into the Nantucket Lightship Closed Area (NLCA) in July 2001 and two trips into the Hudson Canyon Closed Area (HCCA) in June 2001 and September 2001. The goal was to evaluate the performance of the 4" ring dredge in a variety of resource areas, bottom types, with scallop sizes and abundance similar to those expected under an area management strategy and, of course, weather conditions. The gear trials employed a paired design: two dredges, one constructed with 3.5" (89 mm) and the other with 4.0" (102

76 This does not imply that more intensive mariculture methods would be unproductive there.

mm) rings towed simultaneously, side-by-side. The dredges were 15' (4.6 m) wide offshore New Bedford dredges with bags configured as identical as possible, expect for the size of the rings.

A comparison of the relative scallop size distribution captured by each dredge revealed that the 4" ring dredge had a 100% retention size of scallops at approximately 115 mm. Scallops in the 60-95 mm size range were significantly (p=0.005) less vulnerable to capture with the 4" ring dredge relative to the 3.5" ring dredge which effectively provided a window for conservation. In comparison, the 100% retention size for a 3.5" ring dredge was 100 mm, for a 3.25" ring dredge, 90-95 mm, and for a 3.0" ring dredge, 80-85 mm (Burst *et. al.* 2001, DuPaul, *et. al*. 1999).

Catch data for all the trips is summarized in Tables 1 and 2. The evaluation criteria used for this analysis is the number of scallops captured that were 115 mm and larger. This comparison is reflective of all scallops harvested and not what was retained by the crew for shucking. Significant increases in harvest efficiency was noted for five of the eight trips. A slight and non-significant reduction was noted for the second trip to the HCCA where the average size of the scallops harvested was between 110-115 mm. Based on the criteria of 115 mm and above size scallops, the 4" ring dredge performed equally or better than the 3.5" ring dredge with increased efficiencies as high as 18.4%.

Another criteria for evaluating the performance of the 4" ring dredge was the amount of scallops harvested and expressed as weights of shucked meats (Table 3). A significant increase in harvest efficiency was noted for four of the eight trips with non-significant increases noted for three trips. A small non-significant decrease was noted for the September 2001 trip to the HCCA. It must be noted that these results can be influenced by the culling practices of the crew which is influenced by the quantity of scallops harvested and the ex-vessel price of scallops.

The 4" ring dredge significantly reduced the amount of "trash" (invertebrate and debris) retained relative to the 3.5" ring dredge. This reduction is important in considering gear impacts on habitat and most likely had a positive effect on overall gear efficiency (Table 4). Reductions in the amount of "trash" ranged from 13.9% to 40.4% depending on the area fished.

Finfish bycatch was also recorded during the 4" ring dredge gear trials. Minor reductions in finfish bycatch was noted for small fusiform fish (red hake, silver hake, sculpins) and small flatfish (yellowtail flounder <30 cm, four-spot flounder). Potential reductions in finfish bycatch can be realized through reduction in the time the gear is on the bottom to harvest a given amount of scallops. Consequently, the increase in harvest efficiency demonstrated for the 4" ring dredge in areas of high scallop abundance (recovered populations) can be translated to reductions in bottom time and bycatch. Bycatch data for each of the Georges Bank Closed Area trips based on the amount of scallops harvested (per metric ton) is presented in Tables 5, 6 and 7. Data indicate that any reductions in overall finfish bycatch are minimal. Observations for the NLCA are too few to warrant conclusions as the data is from only six tows.

Table 182. Comparison of scallops greater than 115 mm caught by 3.5” rings and 4.0”rings. Paired t-test analyzes the set of tow-by-tow differences in total catch of scallops by each dredge (Goff 2002).

	Number of Tows Sampled	Total 3.5”	Total 4.0”	Percent Increase with 4.0”	Mean Difference per Tow	p-value (paired t-test)
Area II, July 2000	**53**	**15,233**	**18,031**	**18.4%**	**52.8****	**0.0002**
Area II, Sept 2000	**24**	**4,568**	**5,051**	**10.6%**	**20.1****	**0.0018**
Area II, June 2001	**23**	**4,446**	**4,743**	**6.7%**	**13.0***	**0.038**
H. Canyon, June 2001	**27**	**23,978**	**25,501**	**6.4%**	**56.4^{ns}**	**0.092**
H. Canyon, Sept 2001	**31**	**17,529**	**17,295**	**0.0%**	**-7.6^{ns}**	**0.57**
Area I, Oct 2000a	**17**	**41,789**	**49,168**	**17.7%**	**434.1****	**0.0051**
Area 1, Oct 2000b	**16**	**32,083**	**32,440**	**1.1%**	**22.3^{ns}**	**0.43**
Lightship, Aug 2001	**6**	**14,801**	**17,255**	**16.6%**	**409****	**0.0097**

Table 183. Comparison of scallops less than 115 mm caught by 3.5” rings and 4.0”rings. Paired t-test analyzes the set of tow-by-tow differences in total catch of scallops by each dredge (Goff 2002).

	Number of Tows Sampled	Total 3.5”	Total 4.0”	Percent Reduction with 4.0”	Mean Difference per Tow	p-value (paired t-test)
Area II, July 2000	**53**	**179,096**	**171,014**	**4.5%**	**-152.5^{ns}**	**0.27**
Area II, Sept 2000	**24**	**28,224**	**16,591**	**41.2%**	**-484.7****	**0.0001**
Area II, June 2001	**23**	**25,817**	**25,219**	**2.3%**	**-26.0***	**0.021**
H. Canyon, June 2001	**27**	**41,834**	**37,709**	**9.9%**	**-152.8***	**0.015**
H. Canyon, Sept 2001	**31**	**45,937**	**33,789**	**26.4%**	**-391.9****	**0**
Area I, Oct 2000a	**17**	**17,579**	**15,979**	**9.1%**	**-94.1^{ns}**	**0.15**
Area 1, Oct 2000b	**16**	**10,212**	**10,405**	**-1.9%**	**$+12.0^{ns}$**	**0.63**
Lightship, Aug 2001	**6**	**2,151**	**2,688**	**-25.0%**	**$+89.5^{ns}$**	**0.91**

Table 184. Comparison of harvest by 4.0" and 3.5" rings in terms of meat weight (sampled tows only). Meat weights estimated using shell-height:meat-weight models specific to each closed area. These meat weights are only from scallops retained by the crew for processing, not those discarded (Goff 2002).

	Harvest Weight, 3.5" Rings Pounds (Kilograms)	Harvest Weight, 4.0" Rings Pounds (Kilograms)	Percent Increase with 4.0" Rings
Area II, July 2000	**1399 (636)**	**1600 (727)**	**14.4%**
Area II, Sept 2000	**419 (191)**	**478 (217)**	**14.1%**
Area II, June 2001	**1194 (543)**	**1200 (454)**	**0.5%**
H. Canyon, June 2001	**2078 (945)**	**2246 (1021)**	**8.1%**
H. Canyon, Sept 2001	**2096 (953)**	**1948 (885)**	**-7.1%**
Area I, Oct 2000a	**2563 (1165)**	**3073 (1397)**	**19.9%**
Area 1, Oct 2000b	**1887 (858)**	**1951 (887)**	**3.4%**
Lightship, Aug 2001	**1203 (547)**	**1441 (655)**	**19.8%**

Table 185. Comparison of volume of trash (invertebrates and debris, in baskets) retained by 4.0” and 3.5” rings. Data from the Nantucket Lightship trip is excluded due to low sample size (data available for only four tows) (Goff 2002).

Trip	Mean Trash per Tow Retained by 3.5” Rings (baskets)	Mean Trash per Tow Retained by 4.0” Rings (baskets)	Mean Difference per Tow	p – value (paired t test)	Mean Percent Reduction in Trash
Area II, July 2000	**5.94**	**4.67**	**1.27**	**0.003****	***21.4%***
Area II, Sept 2000	**14.42**	**8.60**	**5.82**	**0****	***40.4%***
Area II, June 2001	**6.79**	**4.92**	**1.88**	**0.0003****	***27.7%***
Hudson Canyon, June 2001	**8.63**	**6.67**	**1.96**	**0.0063****	***22.7%***
Hudson Canyon, September 2001	**4.50**	**2.96**	**1.54**	**0.001****	***34.2%***
Area I, Oct 2000a	**4.10**	**3.54**	**0.57**	**0.04***	***13.9%***
Area I, Oct 2000b	**5.73**	**4.69**	**1.04**	**0.0087****	***18.2%***

Table 186. Number of finfish bycatch relative to weight of sea scallops harvested from comparative gear research inside Closed Area I. Trips were conducted 10/2/00 through 10/5/00 and 10/12/00 through 10/16/00.

Common Name	Number per Metric Ton of Retained Scallops (3.5")	Number per Metric Ton of Retained Scallops (4.0")
Skate Uncl.	290.676	245.241
Silver Hake	8.168	3.812
Atlantic Cod	1.922	0.424
Red Hake	5.765	3.388
Fourspot Flounder	32.191	16.942
Yellowtail Flounder	19.218	17.790
Winter Flounder	24.023	20.754
Windowpane Flounder	30.749	27.955
Longhorn Sculpin	38.436	28.802
Sea Raven	11.050	4.659
Monkfish	19.699	13.977
Eelpout Uncl.	1.441	0.424
American Lobster	0.480	0.424
Squid Uncl.	0.480	0.847

Table 187. Number of finfish bycatch relative to weight of sea scallops harvested from comparative gear research inside Closed Area II. Trips were conducted 7/11/00 through 7/19/00, 9/7/00 through 9/10/00 and 6/20/01 through 6/25/01.

Common Name	Number per Metric Ton of Retained Scallops (3.5")	Number per Metric Ton of Retained Scallops (4.0")
Skate Uncl.	5721.114	5680.735
Atlantic Torpedo	0.000	0.892
Silver Hake	850.777	664.017
Atlantic Cod	1.802	0.892
Haddock	1.802	1.785
Red Hake	236.127	158.864
American Plaice	65.791	66.045
Summer Flounder	0.901	0.000
Fourspot Flounder	709.281	559.595
Yellowtail Flounder	2681.209	2640.895
Winter Flounder	15.321	10.710
Witch Flounder	135.187	134.767
Windowpane Flounder	145.101	164.219
Gulf Stream Flounder	0.901	0.000
Longhorn Sculpin	598.428	342.718
Sea Raven	54.976	38.377
Monkfish	352.387	382.881
Eelpout Uncl.	4.506	1.785
American Lobster	0.901	0.892
Squid Uncl.	5.407	5.355

Table 188. Number of finfish bycatch relative to weight of sea scallops harvested from comparative gear research inside the Nantucket Lightship Closed Area. A trip was conducted 8/21/01 through 8/23/01.

Common Name	Number per Metric Ton of Retained Scallops (3.5")	Number per Metric Ton of Retained Scallops (4.0")
Spiny Dogfish	3.448	0.000
Skate Uncl.	351.730	318.727
Red Hake	1.724	0.000
American Plaice	3.448	2.871
Summer Flounder	1.724	0.000
Fourspot Flounder	6.897	2.871
Yellowtail Flounder	36.208	50.250
Winter Flounder	22.414	20.100
Windowpane Flounder	3.448	0.000
Longhorn Sculpin	17.242	8.614
Sea Raven	3.448	7.179
Monkfish	8.621	11.486
Eelpout Uncl.	1.724	1.436

8.2.9 Impacts from reducing dredge width to 13-feet

The alternative to reduce the maximum allowable dredge width from 15 to 13-feet is intended to minimize habitat and bycatch impacts by reducing area swept by commercial fishing gear and inducing changes in fishing locations. Trawls would have a similar reduction in width, but the effects and compensatory mechanisms would be the same. The following analysis shows that reducing the dredge and trawl width probably would not produce any significant changes.

There are several ways that would compensate for reducing the dredge width including,

Changing tow speed
Changing the amount of fishing time per day
Changing tow duration and slightly reducing gear handling time
Fishing closer to home and/or making longer trips
Increasing the day-at-sea allocation to achieve the scallop fishing mortality target

At face value, reducing the dredge width to 13-feet would reduce area swept by 13.3 percent, the ratio of the proposed size to the current size. This alternative had previously been proposed for Amendment 7 to reduce mortality and improve size selectivity. At that time, DuPaul (pers. comm.) compared the effects of the two dredge sizes. He found that, “Reducing the scallop dredge size, in itself, does little or nothing to selectively reduce the PR of age 3+ scallops and does not change the target Fmax. The reduction in dredge size would likely effect all age classes in proportion to the reduction . . . in total width.”

DuPaul pointed out that minor changes in fishing strategies could easily offset any perceived gains in conservation. Comparing data from vessels using 13-foot dredges to ones using 15-foot dredges, DuPaul found some important differences, however. He reported:

"Using catch data (catch per day) for 21 vessels fishing between 1987 and 1991 (N = 1317 trips), the ratio of catch by 13' dredges to the catch by 15' dredges was 0.87. The difference is statistically significant. The horsepower for vessels using 13 dredges was £ 520 and for vessels using 15' dredges, most were 600 to 620. The observed catch ration of 0.87 is almost exactly the same as the calculated or expected ratio for the two dredge sizes."

It is possible that the use of smaller dredges was a result of vessels having insufficient horsepower to tow the larger dredges. The catch differences could be explained as the result of a vessel with less horsepower pulling the smaller dredge at the same speed as another vessel with more horsepower pulling larger dredges. DuPaul furthermore demonstrated that increasing the towing speed by 13.3 percent exactly compensated for the reduced dredge width.

Actually it is even less difficult to compensate for the different width than he indicated. At the time, the catch with 15-foot dredges was less than the shucking capacity of a seven-man crew and fishing was generally continuous while at sea. Fishermen would have to change something to cover the same amount of bottom per day-at-sea, tow speed probably being the most obvious. With a smaller and lighter dredge, tow speed would increase naturally without changing engine rpm or fuel consumption. Towing the gear modestly faster would cause the gear to sweep the same amount of area, presumably having nearly the same mortality and bycatch effects. Towing lighter gear more quickly typically pulls it off the bottom and keeps the gear from fishing effectively. To compensate, fishermen might add more weight to the smaller dredge to keep it on the bottom, causing similar habitat impacts per square foot swept by the two dredges.

Under the present rebuilt conditions, 15-foot dredges catch more scallops than can be processed by the maximum seven-man crew. Fishermen actively fish less time per day by towing for shorter periods or laying to while the crew catches up. Total area swept declines, fishermen seek larger scallops, or the cull size increases to improve shucking capacity[77]. Counter to the previous argument in Amendment 7, size selection for a vessel using a 15-foot dredge may be better than the same vessel and crew using a 13-foot dredge if the catch volume influences fishing location and cull size. On the other hand, a vessel with a 13-foot dredge can now simply increase the number of tows per day or tow duration to easily compensate for the 13.3 percent reduction in catches.

To show how this works, a simple analysis was performed comparing 15 and 13-foot dredge performance when the catch rate ranges from 1,400 to 3,000 pounds per day fished, assuming an average 1,800 pound shucking capacity for a seven man crew[78]. When catch is less than the shucking capacity, total tow time per day is a function of tow duration and the time it takes to handle the gear[79]. Assuming a typical 60-minute tow duration and a 10-minute gear handling time, a vessel can average 20.6 tows per day or 20.6 out of 24 hours in a day-at-sea (Table 189). At higher catch rates, fishermen compensate by taking shorter or fewer tows per day.

Total hours fished declines to 16.8 hours with a 2,200 pound per day catch rate and 12.3 hours per day with a 3,000 pound per day catch rate. This doesn't mean the crew is in the galley playing gin-rummy – actually quite the opposite. To keep up with the high catches, crews also compensate by breaking watches and finding other ways to increase shucking capacity.

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[77] Shown in another DSEIS analysis, crews can shuck more pounds of more valuable large scallops when they are available or shuck fewer small scallops when the catch rates increase.
[78] This is about the landings per day-at-sea observed in the 2001 fishing year.
[79] From the time it is pulled from the bottom and stops fishing to the time it is back fishing on the bottom.

For purposes of analysis, let's assume that the target fishing mortality rate is achieved by allocating 24,000 days used[80] when the scallop biomass and average size translates into a commercial catch per day of 3,000 pounds. Accounting for steam time, average trip duration, towing speed, and tow duration, it translates into 236,983 total hours fished, or 5,265 nm^2, landing 34.56 million pounds of scallops (Table 189, top).

Since effort is classically directly proportional to fishing mortality (assuming all other inputs remain constant), the number of days used must decline as the hours fished per day increases at lower catch rates. Days decline to 17,600 when the catch is at 2,200 pounds per day-at-sea and total fishing time increases to 16.8 per 24 hours. Once the catch rate falls below the shucking capacity, the time fished per day tops out at 20.6 per 24 hours and the days used remains constant at 14,400. Catch per unit effort and landings trend in the same direction, as expected.

For a 13-foot dredge, the effects depend on whether the dredge's catch exceeds the shucking capacity or not (Table 189, bottom). A 13.3 percent decline in the catch rate simply translates into a 13.3 percent increase in total fishing time per day, from 16.8 to 19.4 and from 12.3 to 14.2 hours per day in the two examples. Total hours fished increases from 236,983 hours to 273,442 hours, but the total area swept is exactly the same because the 13-foot dredge sweeps less area per hour fished than the 15-foot dredge (assuming constant speed).

At lower catch rates that are below the shucking capacity, the same swept area and hours fished translate into higher day-at-sea amounts because the time fished per day-at-sea tops out at 20.6 hours (assuming no changes in tow duration or gear handling). Day-at-sea use to achieve 273,442 hours of fishing or constant effort increases from 14,400 to 16,615 days.

Even if days used remain constant, modest changes in inputs controlled by fishermen can easily compensate for the 13-foot dredge. These changes include changing the towing speed, the length of tow, gear handling, trip duration, steam time, or all of them to a minor degree. In nearly all cases, the total amount of area swept (and impacts on mortality and the environment) are the same as with the 15-foot dredge. If applied to situations when the catch rates exceed shucking capacity, these changes could also increase the area swept and impacts more than the present fishing activity, but there is no incentive for fishermen to increase catches as long as the crew and shucking limits remain in place.

Speed

As DuPaul showed in Amendment 7, increasing the towing speed from 4.5 knots to 5.2 knots completely compensates for the reduced dredge width (Table 190). At slower speed, the increases are less dramatic, from 3.0 to 3.5 knots for example. This change does not affect any of the estimates except for area swept, because the longer tow distance is achieved in the same number of hours fished when the gear has equal efficiency. Landings are the same with both dredges.

Tow duration

Instead of increasing speed, fishermen could also compensate for the narrower dredge by increasing tow length or duration, without increasing speed. Actually, the results are more sensitive to differences in gear handling time, but this is more difficult to achieve than simply towing for a longer period.

[80] Not including unused days or Confirmation of Permit Histories.

Doubling the tow duration to 120 minutes and decreasing gear handling time to 7 minutes (Table 191) achieves an increase in total area swept (to 5,030 nm2), but doesn't quite come up to 5,265 nm2 for the 15 foot dredge, all other inputs being equal.

Trip duration and steam time

Increasing trip duration and decreasing steam time increase fishing time per day-at-sea, because vessels take fewer trips with a fixed day-at-sea limit and fishing time becomes a greater proportion of the total trip.

In this case, total hours fished increases to compensate for the reduced dredge width, increasing from 236,983 to 271,543 hours (Table 192). Landings and impacts to the environment would be approximately the same as with a 15-foot dredge, because total area swept would remain the same. Although not unheard of, it would take a trip duration increase from 15 to 24 days and a reduction in steam time from 3 to 2 days (round trip) to achieve these results.

Combination effects

Slight changes in more than one input could also have the same effects and compensate for the smaller dredge width. Increasing tow time by 20 minutes, decreasing gear handling time by 2 minutes, increasing tow speed by just 0.2 knots, and increasing trip duration by 3 days could achieve the same area swept and catches. When the catch rate is less than shucking capacity, hours fished per day increase from 20.6 to 21.8 per 24 hours, days fished increase from 11,520 to 12,000 days, and as a result total hours fished increase from 236,983 to 261,818. The extra tow speed adds to the length of each tow and combined result in the same total area swept, landings, mortality and environmental impacts.

Changes in location

The only remaining element that might change is where vessels with 13-foot dredges fish. This response would be expected if there were differences in the distribution of vessels using the two gear types. Unfortunately, there are not any differences.

Comparisons of vessel trip reports for scallop dredge vessels reveal that there are significant differences in the distribution of fishing for vessels using dredges less than 12 feet vs. vessels using dredges greater than 14 feet. Primarily the former are vessels with a general category scallop permit fishing in exempted fisheries[81]. Clusters of fishing activity have been observed along coastal Maine, along the outer part of Cape Cod, MA, and near Long Island and NJ. Most trips occur near shore on accessible scallop concentrations.

The latter are limited access scallop vessels using 15-foot dredges. Most of these trips occur in traditional scallop fishing areas: around Georges Bank, the Great South Channel, NY Bight, and the Delmarva. Typically, these trips occur farther offshore than for vessels using 10-foot dredges.

In between are limited access scallop vessels using dredges between 12 and 14-feet. Some vessels use smaller dredges for ease of handling or because the vessel has insufficient horsepower to use larger dredges. Differences are difficult to discern between the distribution fishing effort for this fleet and the fleet using 15-foot dredges. Since vessels using 12 to 14 foot dredges tend to fish in the same areas as

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[81] Exempted fisheries are those fishing activities that are allowed because they have less than 5 percent groundfish bycatch. Most of these fisheries are restricted to specific areas, gears, and/or seasons.

vessels using full-size dredges, it is impossible to forecast any changes in fishing patterns due to the smaller dredge.

Table 189. Example comparison of 15 and 13 foot dredges assuming equal day-at-sea allocation. When catches exceed shucking capacity, fishing time per day increases to compensate for the lower catch rate of a 13-foot dredge. Otherwise, increases in tow speed can compensate for the narrower dredge width.

15-foot dredge

Tow duration, minutes	60	**Catch per day, pounds**	1,400	1,800	2,200	3,000
Gear handling time, minutes	10	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	20.6	**Hours per day fished**	20.6	20.6	16.8	12.3
Hours per day fished	20.6	**Total day-at-sea use, F=0.20**	14,400	14,400	17,600	24,000
Tow speed, knots	4.5	**Total days fished**	11,520	11,520	14,080	19,200
Trip length, days	15	**Total hours fished**	236,983	236,983	236,983	236,983
Steam time per trip, days	3	**Total swept area (nm^2), non-overlapping**	5,265	5,265	5,265	5,265
Area swept (nm^2) per hour	0.0222	**Total landed, million lbs.**	16.13	20.74	25.34	34.56

13-foot dredge, constant day-at-sea allocations

Tow duration, minutes	60	**Catch per day, pounds**	1,399	1,799	2,199	2,999
Gear handling time, minutes	10	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	20.6	**Hours per day fished**	20.6	20.6	16.8	12.3
Hours per day fished	20.6	**Total day-at-sea use**	14,400	14,400	17,600	24,000
Tow speed, knots	5.19	**Total days fished**	11,520	11,520	14,080	19,200
Trip length, days	15	**Total hours fished**	236,983	236,983	237,088	237,088
Steam time per trip, days	3	**Total swept area (nm^2), non-overlapping**	5,263	5,263	5,265	5,265
Area swept (nm^2) per hour	0.0222	**Total landed, million lbs.**	16.12	20.73	25.34	34.56

Table 190. Example comparison of 15 and 13 foot dredges assuming equal day-at-sea allocation. When catches exceed shucking capacity, fishing time per day increases to compensate for the lower catch rate of a 13-foot dredge. Otherwise, increases in tow duration and decreases in gear handling time can compensate for the narrower dredge width.

15-foot dredge

Tow duration, minutes	60	**Catch per day, pounds**	1,400	1,800	2,200	3,000
Gear handling time, minutes	10	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	20.6	**Hours per day fished**	20.6	20.6	16.8	12.3
Hours per day fished	20.6	**Total day-at-sea use, F=0.20**	14,400	14,400	17,600	24,000
Tow speed, knots	4.5	**Total days fished**	11,520	11,520	14,080	19,200
Trip length, days	15	**Total hours fished**	236,983	236,983	236,983	236,983
Steam time per trip, days	3	**Total swept area (nm^2), non-overlapping**	5,265	5,265	5,265	5,265
Area swept (nm^2) per hour	0.0222	**Total landed, million lbs.**	16.13	20.74	25.34	34.56

13-foot dredge, constant day-at-sea allocations

Tow duration, minutes	120	**Catch per day, pounds**	1,338	1,720	2,102	2,866
Gear handling time, minutes	7	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	11.3	**Hours per day fished**	22.7	22.7	19.4	14.2
Hours per day fished	22.7	**Total day-at-sea use**	14,400	14,400	17,600	24,000
Tow speed, knots	4.5	**Total days fished**	11,520	11,520	14,080	19,200
Trip length, days	15	**Total hours fished**	261,241	261,241	273,442	273,442
Steam time per trip, days	3	**Total swept area (nm^2), non-overlapping**	5,030	5,030	5,265	5,265
Area swept (nm^2) per hour	0.0193	**Total landed, million lbs.**	15.41	19.81	25.34	34.56

Table 191. Example comparison of 15 and 13 foot dredges assuming equal day-at-sea allocation. When catches exceed shucking capacity, fishing time per day increases to compensate for the lower catch rate of a 13-foot dredge. Otherwise, increases in trip duration or decreases in steam time can compensate for the narrower dredge width.

15-foot dredge

Tow duration, minutes	60	**Catch per day, pounds**	1,400	1,800	2,200	3,000
Gear handling time, minutes	10	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	20.6	**Hours per day fished**	20.6	20.6	16.8	12.3
Hours per day fished	20.6	**Total day-at-sea use, F=0.20**	14,400	14,400	17,600	24,000
Tow speed, knots	4.5	**Total days fished**	11,520	11,520	14,080	19,200
Trip length, days	15	**Total hours fished**	236,983	236,983	236,983	236,983
Steam time per trip, days	3	**Total swept area (nm^2), non-overlapping**	5,265	5,265	5,265	5,265
Area swept (nm^2) per hour	0.0222	**Total landed, million lbs.**	16.13	20.74	25.34	34.56

13-foot dredge, constant day-at-sea allocations

Tow duration, minutes	60	**Catch per day, pounds**	1,213	1,560	1,907	2,600
Gear handling time, minutes	10	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	20.6	**Hours per day fished**	20.6	20.6	19.4	14.2
Hours per day fished	20.6	**Total day-at-sea use**	14,400	14,400	17,600	24,000
Tow speed, knots	4.5	**Total days fished**	13,200	13,200	16,133	22,000
Trip length, days	24	**Total hours fished**	271,543	271,543	313,319	313,319
Steam time per trip, days	2	**Total swept area (nm^2), non-overlapping**	5,229	5,229	6,033	6,033
Area swept (nm^2) per hour	0.0193	**Total landed, million lbs.**	16.02	20.59	29.04	39.60

Table 192. Example comparison of 15 and 13 foot dredges assuming equal day-at-sea allocation. When catches exceed shucking capacity, fishing time per day increases to compensate for the lower catch rate of a 13-foot dredge. Otherwise, modest changes in a variety of fishing strategies can compensate for the narrower dredge width.

15-foot dredge

Tow duration, minutes	60	**Catch per day, pounds**	1,400	1,800	2,200	3,000
Gear handling time, minutes	10	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	20.6	**Hours per day fished**	20.6	20.6	16.8	12.3
Hours per day fished	20.6	**Total day-at-sea use, F=0.20**	14,400	14,400	17,600	24,000
Tow speed, knots	4.5	**Total days fished**	11,520	11,520	14,080	19,200
Trip length, days	15	**Total hours fished**	236,983	236,983	236,983	236,983
Steam time per trip, days	3	**Total swept area (nm^2), non-overlapping**	5,265	5,265	5,265	5,265
Area swept (nm^2) per hour	0.0222	**Total landed, million lbs.**	16.13	20.74	25.34	34.56

13-foot dredge, constant day-at-sea allocations

Tow duration, minutes	80	**Catch per day, pounds**	1,344	1,728	2,112	2,880
Gear handling time, minutes	8	**Shucking capacity per day, pounds**	1,800	1,800	1,800	1,800
Tows per 24 hours	16.4	**Hours per day fished**	21.8	21.8	18.6	13.6
Hours per day fished	21.8	**Total day-at-sea use**	14,400	14,400	17,600	24,000
Tow speed, knots	4.7	**Total days fished**	12,000	12,000	14,667	20,000
Trip length, days	18	**Total hours fished**	261,818	261,818	272,715	272,715
Steam time per trip, days	3	**Total swept area (nm^2), non-overlapping**	5,266	5,266	5,485	5,485
Area swept (nm^2) per hour	0.0201	**Total landed, million lbs.**	16.13	20.74	26.40	36.00

8.2.10 General category alternatives

8.2.10.1 Possession limit

Vessel trip report (VTR) data from 2001 were analyzed for trends in landings to identify potential possession limits for new general category and incidental catch scallop permits. The intent of the two new permits would be to vessels with a general category permit to continue targeting sea scallops and vessels with an incidental catch permit to land scallops captured as bycatch in other fisheries. For purposes of analysis, the trips that might be accommodated by each permit are distinguished by the percent of revenue derived from sea scallop landings. These data were categorized into three percent revenue groups: 100 percent, 50 to 99 percent, and 0 to 49 percent During 2001, 3,606 trips by vessels with general category permits landing sea scallops were reported. The overwhelming majority of VTR trips reporting scallop landings were for trips that landed only sea scallops (Figure 104).

For trips that landed only scallops, there appears to be a strong mode between 350 and 400 pounds, with a relatively uniform distribution of trips landing between 50 and 325 pounds (Figure 104). These landings are constrained by the present 400-pound scallop possession limit and the unconstrained distribution in 2001 could have a higher mode. There is a scatter of trips with scallop landings greater than 400 pounds. Some of these could be landings by vessels with limited access permits that were not matched correctly with the landings. Some may also be aggregated VTRs for multiple, single-day trips. Fishermen may be submitting reports for more than one daily report and reporting them as a 'trip'. Nearly all of the trips with more than 400 pounds landed in MA, which has a state exemption from the scallop day-at-sea regulations for vessels targeting scallops within state waters.

Although much lower in number, the landings distribution for trips where scallop revenue was between 50 and 99 percent appears to be very similar to the distribution of scallop landings when scallops were the only species landed. These trips are ones that scallops were targeted by other species were also landed, presumably as bycatch.

When scallop landings contributed to less than 50 percent of the total trip revenue, the landings distribution was much different than when the vessels targeted scallops (Figure 104). The majority of trips had scallop landings between 50 and 175 pounds when scallop revenue was less than 50 percent of the trip value. From these data, it appears that the majority of trips would not be forced to discard scallop bycatch with a 150 to 200 pound possession limit.

Other ways of examining these VTR data are informative about the disposition of this fleet sector and its attributes. The majority of trips landing scallops were by vessels using scallop dredges, apparently targeting sea scallops (Figure 105). Second in number of trips are vessels using nets. Within this gear category, there appear to be some trips targeting sea scallops and landings around 400 pounds, constrained by the present possession limit. A second mode appears around 100 pounds, apparently from vessels targeting other species and landing scallops as a bycatch.

Scallop landings per trip for vessels using nets tend to increase as the percent of revenue from scallops increases (Figure 105). Due to its high value per pound, summer flounder appears to be a significant component of the landings when scallop revenue is about 50 percent of the total (Table 193). When scallop revenue is a lower proportion of the total (e.g 40 percent or less), groundfish and skates appear to be a significant component of landings.

Most of the trips by vessels with general category permits targeting sea scallops appear to land in MA, ME, and NJ (Figure 106). Targeting of sea scallops and landing about 400 pounds of sea scallops appeared more prevalent in MA and NJ during 2001. Most of the scallop landings in ME were less than 200 pounds, according to the VTR data, presumably when the

Crew size also seems to be a significant correlate with general category vessels targeting sea scallops. Vessels with crews of three or four people tend to target sea scallops and have landings near the possession limit than vessels carrying one or two crewmembers (Figure 107). Presumably, the vessels carry a few more crewmembers to handle the heavy scallop dredge and to shuck scallops.

On a per day basis, the distribution of landings when scallops were the only species landed appears to be very similar to the landings for the entire trip (comparing Figure 108 to Figure 107). A large majority of these trips are day trips where the daily possession limit prevents vessels from making more than one trip per day. When scallop revenue is a less than half of the total trip revenue, the distribution of scallop landings per day absent is less than the scallop landings for the trip, presumably because general category vessels that land their scallop bycatch tend to take multi-day trips. The majority of landings are made by trips that have less than 100 pounds per day absent.

Compared to trip duration, scallop landings appear to be consistent with trips targeting scallops (see Figure 104) when the trip length is one day. Scallop landings have a strong mode about the 400-pound scallop possession limit (Figure 109). The distribution of landings per day also has a mode near the 400-pound possession limit (Figure 110), indicating either that these longer trips also target scallops, or that scallop bycatch on trips targeting other species is higher than 400 pounds.

In 2001, there were 133 trips (107 by vessels using dredges) that had scallop revenue greater than 50 percent of the trip total. The average landings per trip was about 400 pounds and it appeared that these longer trips targeted scallops, especially for vessels using dredges (Table 194). There were also 41 trips (38 by vessels using nets) where scallop landings accounted for less than 50 percent of the trip revenue. Average scallop landings for these trips were 150 pounds, or 78 pounds per day absent. Trips longer than two days appear to be targeting other species and most of the landings per day were less than 100 pounds.

From Figure 104 and Figure 108, it appears that a possession limit of 200 pounds per trip and 100 pounds per day-at-sea would be sufficient to accommodate scallop bycatch for vessels targeting other species, analyzed above as trips having scallop revenue less than 50% of the total trip revenue. Unlike other managed species, bycatch mortality of sea scallops is generally very low (i.e. 10 percent or less). Setting a reasonable possession limit that prevents vessels from using a new incidental catch permit to target scallops is unlikely to cause significant discard mortality.

For the vessels targeting sea scallops, it appears that vessels can catch and land more than 400 pounds in a day trip. Higher limits might be appropriate if compliance and fishing costs for these vessels increase or the scallop biomass increases in areas where these vessels fish (see distribution of trips by vessels using dredges less than 12 feet in Map 45 in the DSEIS), as it would following a rotation management area closure. Unfortunately, cost data for vessels holding general category scallop permits is sparse and it is therefore difficult to analyze profitability.

Table 193. Percent of revenue from species caught on trips by vessels with general category permits landing sea scallops. Data are from VTRs for trips by vessels with general category permits in 2001.

Percent from scallops	Number of trips	Average scallop landings (pounds)	Summer flounder	Squid	Monkfish	Skate	Groundfish	Lobster	Other species
0	99	1.9%	1.4%	0.8%	4.9%	7.7%	79.9%	3.0%	5.7%
10	55	8.9%	20.2%	1.5%	3.4%	13.9%	49.0%	2.2%	3.3%
20	32	20.9%	6.7%	2.5%	3.9%	11.1%	51.3%	2.0%	6.3%
30	9	27.8%	12.2%	0.0%	5.5%	14.4%	38.3%	1.3%	1.8%
40	12	45.1%	15.8%	0.0%	2.7%	1.6%	32.9%	1.2%	8.9%
50	18	51.4%	32.1%	0.1%	2.0%	0.0%	13.1%	0.5%	6.1%
60	14	59.1%	30.2%	0.0%	2.6%	1.4%	6.1%	0.0%	0.8%
70	9	72.9%	7.7%	5.2%	2.7%	0.1%	10.8%	0.1%	4.4%
80	16	80.4%	7.6%	0.2%	0.9%	0.0%	8.1%	1.7%	1.0%
90	18	91.2%	3.5%	0.0%	2.2%	0.2%	2.3%	0.1%	0.7%
100	166	94.5%	0.2%	0.0%	0.1%	0.0%	0.5%	0.0%	0.1%
Grand Total	448	21.6%	3.6%	0.7%	3.7%	6.3%	56.5%	2.1%	4.2%

Table 194. Average scallop landings per trip and per day absent versus trip length and percent of trip revenue from scallop landings (0 –49 percent, 50-99 percent, and 100 percent). Top portion of table are for vessels using scallop dredges and the bottom part of the panel are for vessels using nets. Source: Summaries from VTRs from vessels having a general category scallop permit and landing scallops during 2001.

	Percent class	Data							
	0-49			50-99			100		
Trip duration	Trips	Landings per trip	Piv	Trips	Landings per trip	Piv	Trips	Landings per trip	Piv
1	2	136	103	98	497	486	2,918	408	403
2	2	350	182	19	496	263	88	403	224
3				3	369	123	7	615	238
4	2	360	85				4	358	99
5				1	370	67	2	399	86
6				2	1,337	213	3	294	51
9							1	17,000	1,947
16				1	34,000	2,068			
Grand Total	**6**	**282**	**123**	**124**	**777**	**448**	**3,023**	**414**	**397**

	Percent class	Data							
	0-49			50-99			100		
Trip duration	Trips	Landings per trip	Piv	Trips	Landings per trip	Piv	Trips	Landings per trip	Piv
1	75	103	99	72	1,269	1,261	121	476	470
2	38	141	73	16	364	205	10	741	378
3	13	101	34	4	313	108	3	124	41
4	15	220	60	2	164	40	1	160	38
5	10	164	33	1	247	48			
6	16	128	22						
7	9	100	14						
8	17	117	14						
9	16	159	18						
10	7	188	19						
11	2	280	26						
Grand Total	**218**	**132**	**60**	**95**	**1,042**	**996**	**135**	**486**	**450**

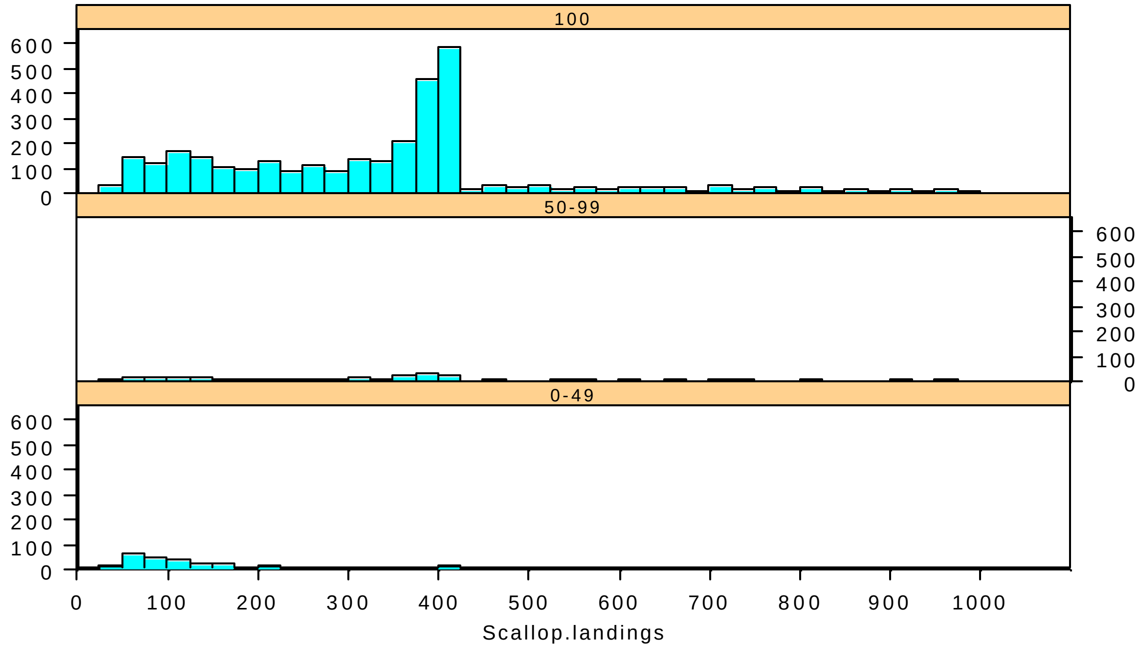

Figure 104. Scallop landings per trip compared to the percent of revenue derived from scallop landings. Data from 2001 VTRs by vessels with general category scallop permits reporting scallop landings.

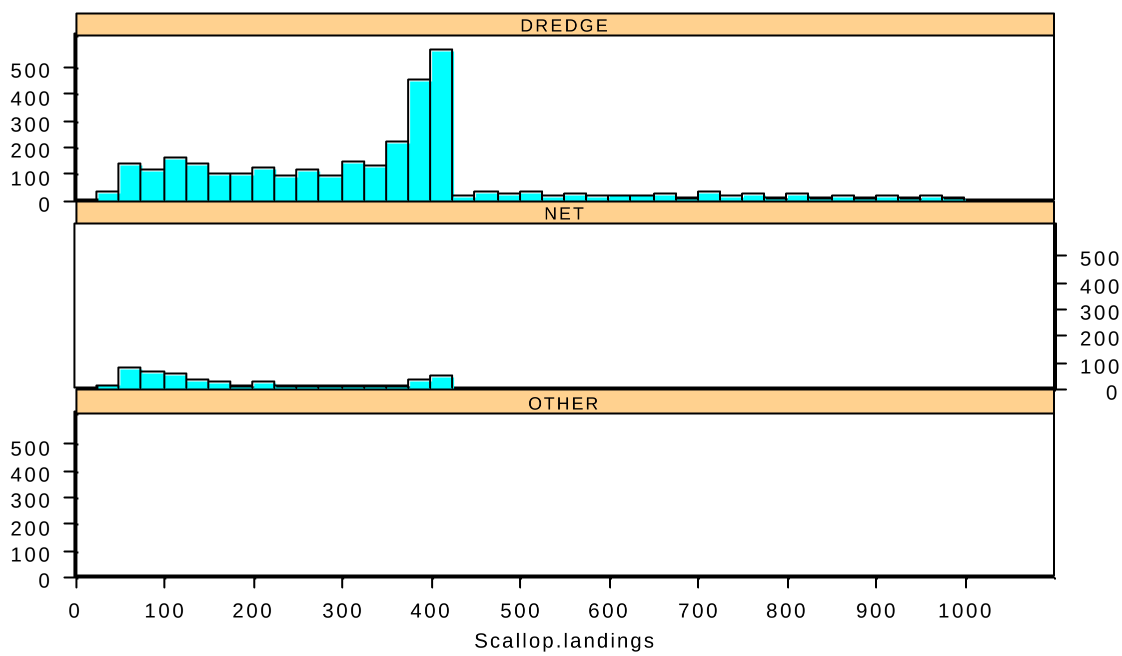

Figure 105. Scallop landings per trip by fishing gear. Data from 2001 VTRs by vessels with general category scallop permits reporting scallop landings.

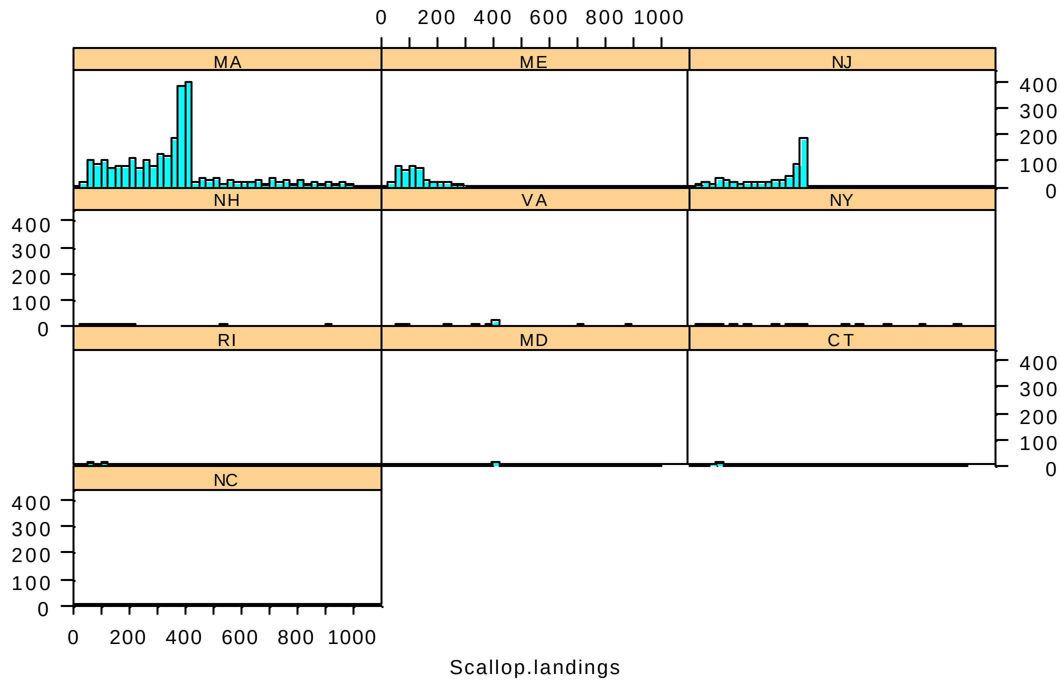

Figure 106. Scallop landings per state of landing for vessels with general category scallop permits. Data from 2001 VTRs by vessels with general category scallop permits reporting scallop landings.

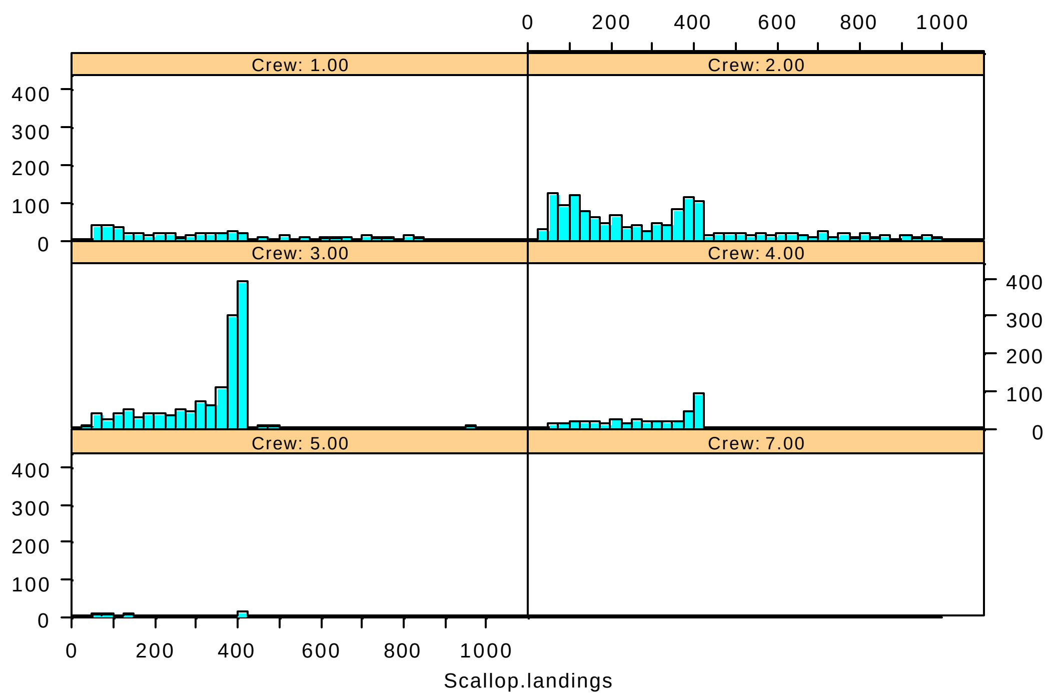

Figure 107. Scallop landings by number of crew for vessels with general category scallop permits. Data from 2001 VTRs by vessels with general category scallop permits reporting scallop landings.

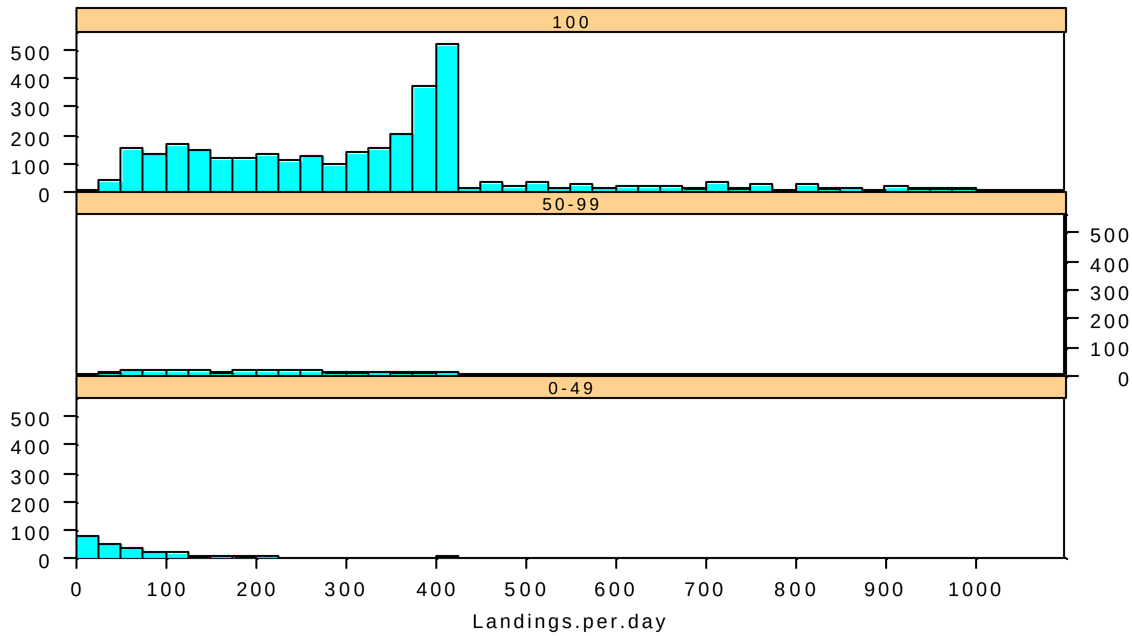

Figure 108. Scallop landings per day absent compared to the percent of revenue derived from scallop landings. Data from 2001 VTRs by vessels with general category scallop permits reporting scallop landings.

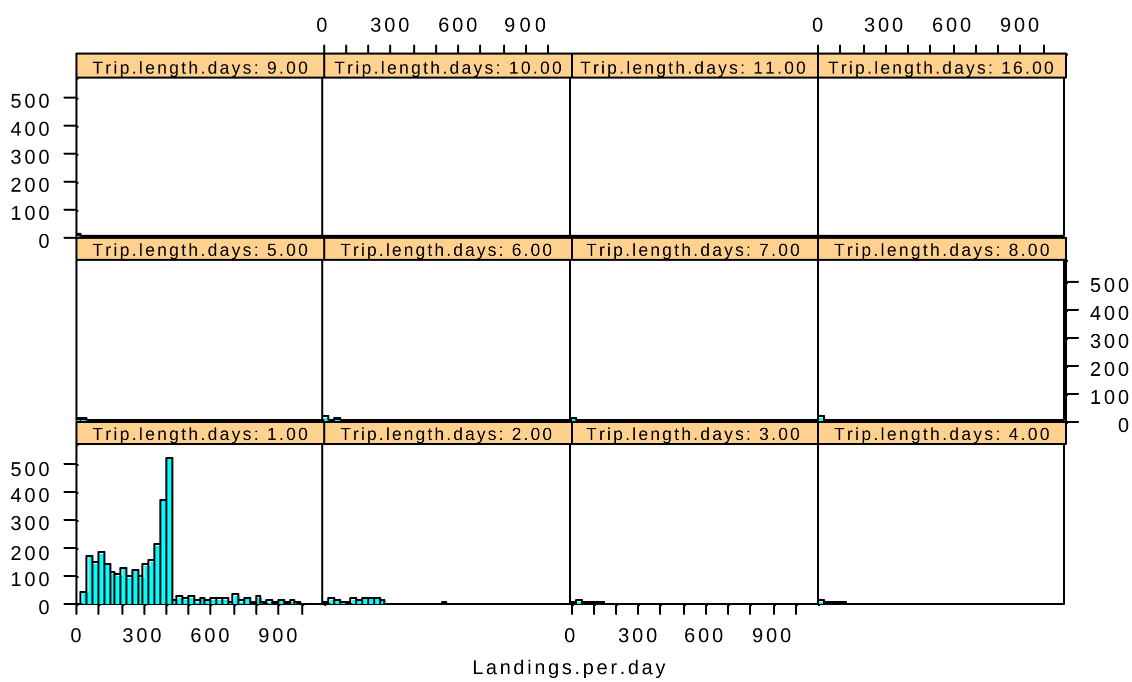

Figure 109. Scallop landings per day absent compared to trip duration (days absent). Data from 2001 VTRs by vessels with general category scallop permits reporting scallop landings.

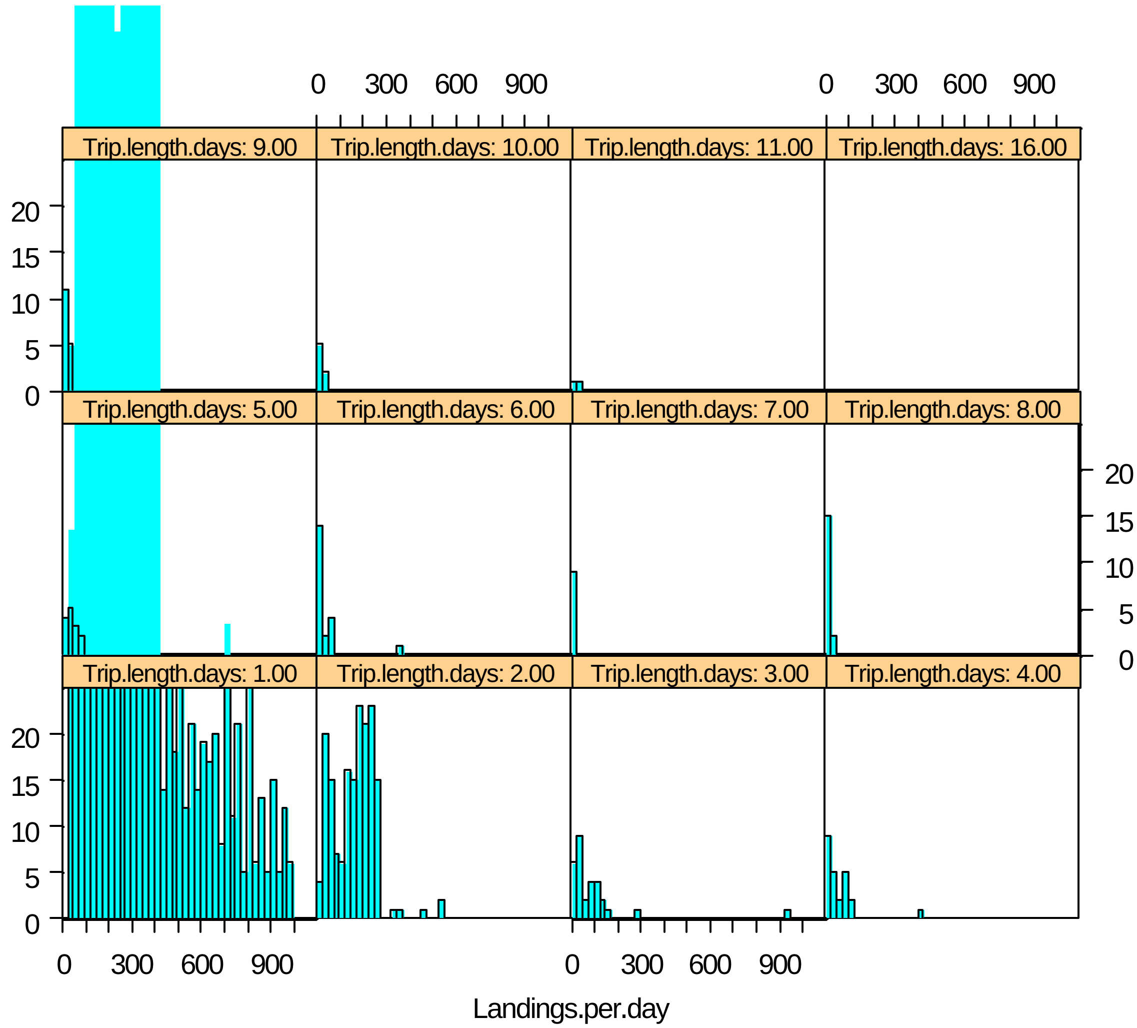

Figure 110. Scallop landings per day absent compared to trip duration (days absent). Y-axis is re-scaled to show the trip distribution relative to landings per day absent for trips longer than one day. Data from 2001 VTRs by vessels with general category scallop permits reporting scallop landings.

8.2.10.2 Prohibiting limited access vessels from targeting sea scallop while not on a day-at-sea

Most limited access scallop vessels derive little additional income from the landings of scallops while not on a day-at-sea, but vessels with part-time and occasional scallop permits derive a greater share of scallop revenue from trips not on a day-at-sea and there is variability between vessels in this regard. Although prohibiting vessels with limited access scallop permits from targeting scallops while not on a day-at-sea (by lowering the possession limit to 40 pounds) will reduce revenue for them, this loss will partly be made up through day-at-sea allocations (see also Section 7.7.4.10 for a discussion of the economics of this re-allocation within a permit category) and by fishing for other species.

The benefit of this alternative is to improve the effectiveness of using day-at-sea limits to prevent overfishing, without which increasing effort in the open access general category fishery could reduce the day-at-sea allocations or run the risk of overfishing the resource.

From 1999 to 2002, an average of 67 full-time, 20 part-time, and 6 occasional vessels landed less than 400 pounds of scallops at a dealer (Table A). This is 25%, 68%, and 40% of the vessels using their day-at-sea allocations in 2001, assuming that vessels targeting scallops while not on a day-at-sea were using scallop days sometime during the 2001 fishing year.

Full-time vessels averaged 322 trips per year, or 4.8 trips per vessel (Table A), or about four percent of a 120-day allocation. The number of trips and total scallop landings on trips with less than 400 pounds, as well as the average scallop catch per trip decline through this period. This downward trend reverses the one observed for day-at-sea use and catches as the resource rebuilt to the target. On average, full-time vessels landed 92,824 lbs. of scallops, or 1,385 lbs. per vessel (less than a day's catch on a limited access trip with a seven-man crew and two dredges). These landings were only 0.3 percent of the scallop landings by full-time scallop vessels when fishing on a day-at-sea. Except for 2002, most trips by full-time scallop vessels when not on a day-at-sea appear to be targeting scallops, landing 310 to 322 pounds (over 75 percent of the scallop possession limit) and contributing to more than half the revenue for the trip. In 2001, the average annual revenue per vessel ($8,089) was only 1.3 percent of the total average scallop revenue per vessel (Table B).

Because of higher amounts of scallop fishing while off the day-at-sea clock and a lower day-at-sea allocation, the proposed prohibition would affect a greater proportion of revenue for part-time scallop vessels. And since any re-allocation of days due to lower general category landings would be in proportion to the base day-at-sea allocations, vessels with part-time scallop permits would be unlikely to recoup their loss through a greater day-at-sea allocation.

Part-time vessels appear to supplement their scallop fishing income off the day-at-sea clock more frequently. The trips and landings do not show the same trend as those for full-time vessels, reaching a peak in 2001 with 322 trips and 100,659 lbs. (Table A). Only 20 part-time vessels, on average, had trips with landings less than 400 pounds, but the scallop landings and revenues per vessel were more substantial. These vessels averaged 235 trips (or 11.8 per vessel), which had average landings of 327 lbs. per trip. Unlike the full-time vessel activity, these trips appear to continue to target scallops right into 2002, when the average catch per trip was 355 lbs., making up more than half of the revenue on trips landing sea scallops. During the period, the part-time vessels averaged 68,908 lbs. per year, or 3,445 lbs. per vessel annually. In 2001, the revenue from scallop landings from trips not on a day-at-sea was 11 percent of the scallop revenue from day-at-sea trips (Table B).

The amount of scallop revenue is insignificant for vessels with occasional scallop permits from trips not on a day-at-sea, averaging 267 pounds per year while using dredges, or 45 pounds per vessel. Landings per trip averaged 152 lbs., when including landings from all gear types. Although there were apparently some trips that targeted sea scallops in 1999, the average landings per trip and the proportion of revenue from scallop landings on these trips declined in 2000-2002, averaging less than 20 percent, indicating that most vessels with occasional scallop permits were targeting other species.

Table A. Average annual landings and revenue by vessels with limited access scallop permits, for trips landing less than 400 pounds of scallop meat.

Category & Number of vessels using 2001 DAS	Fishing year	Number of vessels	Trips	Average catch per trip (lbs)	Scallop landings using dredges	Percent of DAS scallop landings.	Average scallop price	Percent of revenue from scallop landings
Full-time	1999	85	475	322	149,011	0.7%	$6.49	78.7%
	2000	72	342	317	98,548	0.3%	$5.97	66.5%
252	2001	63	352	310	98,541	0.3%	$4.67	57.5%
	2002	48	119	247	25,197	0.1%	$4.20	30.5%
Full-time average		***67***	***322***	***311***	***92,824***	***0.3%***	***$5.33***	***64.5%***
Part-time	1999	20	159	274	38,830	4.2%	$6.19	63.1%
	2000	19	279	338	83,912	5.3%	$6.87	91.6%
38	2001	26	322	329	100,659	4.3%	$5.07	63.0%
	2002	16	178	355	52,231	2.4%	$4.42	58.5%
Part-time average		***20***	***235***	***327***	***68,908***	***3.9%***	***$5.64***	***70.3%***
Occasional	1999	4	12	248	0	14.5%	$4.70	40.3%
	2000	5	17	111	0	6.0%	$4.56	15.2%
20	2001	8	29	126	694	5.1%	$4.28	19.1%
	2002	7	23	164	372	6.4%	$4.44	17.9%
Occasional average		***6***	***20***	***152***	***267***	***6.8%***	***$4.49***	***20.6%***

Table B. Comparison of 2001 scallop revenue per vessel derived from landings while on a day-at-sea trips vs. landings of less than 400 lbs. while not on a day-at-sea.

	Full-time	**Part-time**	**Occasional**
Number of vessels that took GC (<=400 lb.) trips	63	26	8
Number of <=400 lb. trips	352	322	29
Average catch (lbs) per trip	310	329	126
Average annual landings per vessel (lb)	1,732	4,075	457
Average ex-vessel price	4.67	5.07	4.28
Average annual revenue per vessel from GC (<=400 lb) trips	8,089	20,658	1,955
Average annual revenues from DAS trips	617,422	188,256	9,750
The revenue from GC trips as a % of revenue from DAS trips	1.31%	10.97%	20.05%