

## 5.3.2 Methods

### 5.3.2.1 *Survey design and estimation of current total biomass*

Catch data stratified by two factors: 1). North and South 2). inside and outside the closed area are shown in Table 172. The initial biomass estimate is shown in Table 173. The following assumptions were used in calculating biomass:

1. Stratification of the closed area into two roughly equal portions.
2. Utilizing a systematic grid design, number of stations was proportional to area of strata.
3. Tows that fell on closed area boundary were included in the calculation.
4. All scallops harvested were included
5. The coefficients of the shell height-meat weight relationship:  $a=-12.1628$   $b=3.2539$ .
6. A nominal tow length of 1.0 nm. Each tow covered  $0.00494 \text{ nm}^2$ .
7. A dredge efficiency of 40%
8. Harvest represents a removal of 25% of the standing stock.

The next iterations of biomass estimates will follow accordingly:

9. The number of scallops from 80-100 mm will be corrected for the selectivity of the 3.5" ring dredge. This means that the total number of scallops at each 5 mm interval from 80-100 mm will increase. Consequently, their contribution will also increase the biomass estimate. We will still use the nominal tow length of 1 nm and a 40% dredge efficiency.
10. The biomass estimate in 1 will be calculated to account for actual tow length and changes in dredge efficiency based on the 1999 depletion experiments in the Hudson Canyon Closed Area on 100+ mm scallops.
11. The biomass estimate in 9 will be calculated to account for growth and natural mortality (0.1) to project the standing stock in 2001.

### 5.3.2.2 *Biomass projections through 2001*

The depth stratified length frequency data from the June 2000 experimental fishery (Table 175) were advanced by one year, to account for growth and natural mortality between June 2000 and June 2001, giving a future biomass and total allowable catch (TAC) estimate for the next fishing year, when the Hudson Canyon Area is likely to re-open. Only the grid design survey tows were retained to estimate

biomass in each depth stratum, so that the area for each stratum could be estimated from the proportion of the number of tows at depth. The number of surviving scallops at size were estimated by deducting natural mortality (M) with the catch equation and estimated to grow by a von Bertalanffy growth equation and shell-height meat weight relationship, both sets of parameters reported by the SAW 29 (NEFSC 1999). For scallops greater than the asymptotic length, growth was assumed to be zero but the number of scallops were reduced by M. Scallops less than 80 mm were excluded from the analysis because most would not become fully-recruited to the fishing gear by 2001.

In combined form, biomass in 2001 was estimated as follows:

$$B_{2001} = N_l * e^{-M} * e^{-a} * [L * (1 - e^{-k(t-t_0)})]^b * L_t$$

The following parameters were used in the estimate:

Parameter	Value
M	0.2
L <sub>g</sub>	151.84 mm
K	0.2297
t <sub>0</sub>	1.1256
a	12.1628
b	3.2539

An the equation above can be simplified to:

$$B_{2001} = 0.427e^{-7} * N_l * [151.84 * (1 - e^{-k(t-1.1256)})]^{3.2539} * L_t$$

### 5.3.3 Total Allowable Catch

The total exploitable biomass in the Hudson Canyon and VA/NC closed areas is summarized in Table 176. Current and projected biomass for the Hudson Canyon Area was estimated from the June 2000 experimental fishery, conducted by Dr. William DuPaul, Virginia Institute of Marine Science. In lieu of experimental fishery data for the VA/NC Area, the 2000 Albatross survey data was used and projected to 2001 in the “New Closure” scenario, described in Section 5.1.2 and 5.4. According to these two projections, the biomass in the Hudson Canyon and VA/NC closed areas is expected to grow by 27 percent from June 2000 to June 2001. Total exploitable biomass is predicted to be 62 million lbs. in the Hudson Canyon Area and 6 million lbs. in the VA/NC Area.

Biomass estimates and projections from the 1999 Albatross survey are summarized in the lower half of Table 176. According to these projections, exploitable biomass is expected to increase by 37 and 73 percent from 1999 to 2001, in the Hudson Canyon and VA/NC closed areas, respectively. The total exploitable biomass is predicted to be 101 million lbs. in the Hudson Canyon Area and 8 million lbs. in the VA/NC Area.

**Table 176.** Biomass estimates for the Hudson Canyon and VA/NC closed areas from experimental fishery and R/V Albatross survey data. Projected biomass for 2001 was estimated by the method described in Section 5.3.2.2 for abundance estimates in the experimental fishery data.

The 1999 Albatross survey biomass was projected to 2001 with methods described in Section 5.1.2. These results apply to the Low F and High F scenarios, described in Section 5.1.

<b>Low F Scenario</b>	<b>Hudson Canyon</b>	<b>VA/NC Area</b>
<b>2000 Experimental Fishery</b>		
Number of samples	94	19
Stratified mean weight/tow (kg)	29.81	5.10
Standard deviation		
Mean total biomass (million lbs.)	48.79	4.57
Projected total biomass 2001 (million lbs.)	62.18	6.03
Projected percent change in biomass in 2000 - 2001 at survey	27.4%	32.0%
<b>Projections based on 1999 Annual Albatross Survey</b>		
Number of samples	39	19
Mean number/tow (full recruits)	952.39	374.58
Mean weight/tow 1999 (kg)	6.56	5.29
Mean weight/tow 2001 (kg)	16.43	8.83
Swept-area biomass 1999 (million lbs.)	29.75	4.61
Projected 2000 swept-area biomass (million)	73.79	6.38
Projected 2001 swept-area biomass (million)	100.99	7.97
Projected percent change in biomass in 1999 - 2001 at survey	36.9%	72.7%

Applying an exploitation rate consistent with  $F = 0.2$  ("Low F") and  $0.3$  ("High F"), gives TACs of 14.6 (6,605 mt) to 20.8 (9,431 mt) million lbs. for two options (Table 177 and Table 179, respectively). One-percent of these TACs, totaling 291,000 to 416,000 lbs. would fund scallop research and observer coverage, leaving 14.3 to 20.4 million pounds to determine trip allocations and potential trip limits for accessing each closed area.

**Table 177.** Adjustment of 1999 and 2000 biomass estimates and calculation of 2001 scallop TACs for access to the Hudson Canyon and VA/NC closed areas. This option assumes that fishing mortality equals 0.2 in these areas, consistent with the "Low F" scenario.

<b>Low F Scenario</b>	<b>Hudson Canyon</b>	<b>VA/NC Area</b>	<b>All</b>
<b>Mean biomass estimate</b>			
2000 average (million lbs.)	61.29	5.47	66.76
2001 projected swept area biomass (million l	81.59	7.00	88.59
TAC (million lbs.) at $F=0.2$	13.46	1.10	14.56
TAC (mt) at $F=0.2$	6,107	498	6,605
Set asides (lbs.)	269,278	21,960	291,239
Fishery TAC (million lbs.)	13.19	1.08	14.27

**Table 179.** Adjustment of 1999 and 2000 biomass estimates and calculation of 2001 scallop TACs for access to the Hudson Canyon and VA/NC closed areas. This option assumes that fishing mortality equals 0.3 in these areas, consistent with the "High F" scenario.

High F Scenario	Hudson Canyon	VA/NC Area	All
<b>Mean biomass estimate</b>			
2000 average (million lbs.)	61.29	5.47	66.76
2001 projected swept area biomass (million l	81.59	7.00	88.59
TAC (million lbs.) at F=0.3	19.22	1.57	20.79
TAC (mt) at F=0.3	8,719	711	9,431
Set asides (lbs.)	384,455	31,372	415,827
Fishery TAC (million lbs.)	18.84	1.54	20.38

### 5.3.4 Trip allocations and trip limits

To estimate the number of trips that can be allocated, the fishery TAC (Table 177 and Table 179) is simply divided by the trip limit that would apply if it were assumed that any trip into the closed area will catch the allowable trip limit. For example, the 20.4 million pound TAC for the Hudson Canyon Area can allow for 2,038 trips with a 10,000 pound trip limit. Similarly, the total number of 15,000-pound trips to catch 1.5 million lbs. in the VA/NC Area is 102 trips. Because the area is small and remote to most large scallop ports, the PDT assumed a 50 percent participation rate for the purposes of evaluation and discussion.

Determination of how many trips to allocate to each vessel is a little more complicated, however. The first step is to determine how many vessels are likely to participate. Consistent with the successful policy for Framework Adjustments 11 and 13, the PDT assumed that all vessels with active permits would fish in the Hudson Canyon Area. There are 328 limited access scallop vessels with active permits, including 276 that used one or more scallop days-at-sea in 2000 (Table 158). This does not include the 64 Confirmation of Permit Histories that could be assigned or transferred to a suitable scallop fishing vessel to take advantage of the new opportunities and the higher (predicted) catch rates.

For an initial estimate of the number of trips that vessels in the three categories could take, it was assumed that the day-at-sea allocations would remain at 2000 levels (i.e. 120 full-time days) and that the day-at-sea tradeoff is 10 days for each trip into a closed area. Since an occasional vessel would only have 10 days-at-sea to fish for scallops, the maximum number of trips it could take is therefore one. Similarly, a part-time vessel with 48 days-at-sea could at most take four trips to the closed areas. Different day-at-sea tradeoffs would imply that the part-time and occasional vessels might be able to take more or fewer trips, but the overall difference would be slight.

Given the number of vessels with each type of limited access permit and their assumptions about fishing in each closed area, the number of trips to allocate is either three to nine in Hudson Canyon Area (Table 181 and Table 183). Lower trip limits imply that more trips could be allocated, since each trip would land a smaller fraction of the TAC. Due to the assumption about participation by 138 vessels in VA/NC Area, rather than all active permits (276), the potential allocations for VA/NC range from zero to one trip.

Together, three to four trips (depending on the choice of harvest rate) could be allocated (Table 181 and Table 183) to limited access vessels to fish with an 18,000 lbs. trip limit (occasional vessels taking only one trip), and up to nine trips with an 8,000 lbs. trip limit (occasional vessels taking one trip, part-time vessels taking four trips). If a vessel takes all the trips it might be allocated to fish in the closed areas and there is a ten day-at-sea tradeoff, these trips could use up 25 to 75 percent of the total days allocated, assuming 2000 allocations continue. Lower possession limits for a fixed day-at-sea tradeoff, or a higher day-at-sea tradeoff for a fixed possession limit could significantly reduce fishing effort and mortality in other scallop fishing areas, promoting rebuilding.

**Table 181.** Low F scenario: Assumed vessel participation, maximum trip allocations for trip limits, and potential TAC fractions for access to the Hudson Canyon and VA/NC closed areas.

<b>Low F Scenario</b>	<b>Hudson Canyon</b>	<b>VA/NC Area</b>	<b>All</b>
<b>Expected vessel participation</b>			
Full-time	222	111	
Part-time	30	15	
Occassional	24	12	
Total estimated participation	276	138	
TAC per vessel	48,782	7,957	56,739

<b>Trips limit (lbs. meat weight)</b>	<b>Total number of trips to allocate</b>			
8000	1,649	135	-	1,784
10000	1,319	108	-	1,427
12000	1,100	90	-	1,189
15000	880	72	-	951
18000	733	60	-	793

<b>Trips limit (lbs. meat weight)</b>	<b>Number of trips per vessel to allocate</b>			
8000	6	0		6
10000	5	0		5
12000	4	0		4
15000	3	0		3
18000	2	0		3

**Table 183.** High F scenario: Assumed vessel participation, maximum trip allocations for trip limits, and potential TAC fractions for access to the Hudson Canyon and VA/NC closed areas.

<b>High F Scenario</b>	<b>Hudson Canyon</b>	<b>VA/NC Area</b>	<b>All</b>
<b>Expected vessel participation</b>			
Full-time	222	111	
Part-time	30	15	
Occassional	24	12	
Total estimated participation	276	138	
TAC per vessel	69,648	11,367	81,014

<b>Trips limit (lbs. meat weight)</b>	<b>Total number of trips to allocate</b>			
8000	2,355	192	-	2,547
10000	1,884	154	-	2,038
12000	1,570	128	-	1,698
15000	1,256	102	-	1,358
18000	1,047	85	-	1,132

<b>Trips limit (lbs. meat weight)</b>	<b>Number of trips per vessel to allocate</b>			
8000	9	1		9
10000	7	1		7
12000	6	0		6
15000	5	0		5
18000	4	0		4

The TAC for the VA/NC area is low because the size of the area is small, but the size of the scallops are near the optimum size for maximizing yield-per-recruit. As such, it makes sense to choose a higher harvest rate and allow the fishery to close from the TAC rather than the trip allocation (some to

vessels that may not participate in the VA/NC Area). An option that makes sense is to allocate the total trips for vessels to fish in either area. One possible outcome is that some vessels (especially from VA and NC) will take all of their access program trips in this area even though the majority of the allocation is justified from the large biomass in the Hudson Canyon Area. Since the scallops are larger in the VA/NC area, benefits would be greater by allowing the maximum number of trips to be taken in the VA/NC area until the catch reaches the VA/NC Area TAC.

Another benefit of this strategy is that it does not force vessels to take access program trips to an area farther from port than necessary. Some vessels from NJ and New England may take all of their trips in the HCCA, reducing travel costs. At the same time, this shift might be compensated by vessels in VA and NC taken as many trips as possible in the VA/NC area. Some vessels may be able to take three or four trips there before it closes when the scallop catch meets the TAC and take fewer trips in the more-distant Hudson Canyon Area where coincidentally scallops are smaller.

### **5.3.5 Fractional TAC**

Another option for managing the fishery in the Hudson Canyon and VA/NC closed areas is to temporarily allocate a vessel's fraction of the TAC and associate a day-at-sea tradeoff with the amount of scallops landed from trips taken within these areas. The pros and cons of this strategy are discussed in Section 6.2.2.

While estimating participation by vessels that is less than the total has some benefits for allocating trips, allocating fractional TACs to vessels and assuming less than 100 percent participation could have problems since some vessels might not be able to land their share before one or both areas close when the scallop catch reaches the overall TACs. Under the Low F and High F scenarios, respectively, the Council could allocate up to 52,270 to 74,628 lbs. ( $1/276^{\text{th}}$ ) of the TAC in the Hudson Canyon Area. For the VA/NC Area, the fractional TAC would be 7,957 to 11,367 lbs. if only half of the vessels participate or  $1/276^{\text{th}}$  of the TAC if all active vessels were presumed to participate. Both fractions would be cut (to  $1/340^{\text{th}}$  of the TAC) if all permits, including Confirmation of Permit Histories, received fractional shares of the TACs.

As with the above option, the fractional TACs could be allocated individually or combined. If combined, they would have the same benefits (vessels may fish closer to port) and costs (the VA/NC Area might develop into a derby fishery).

## **5.4 New Area Closures**

The Council requested that the Scallop PDT review and evaluate the possible benefits of closing some open areas during 2000 to conserve small scallops and increase benefits. This section describes the PDT recommendations and provides some preliminary estimates of yield potential from closing the areas. These estimates do not take into account the impacts caused by effort shifts into the remaining open areas, nor does it estimate catches for the resource. A more complete analysis of the net impacts of the proposed closures is presented as a "New Closure" scenario in Sections 5.1 and 5.4.

The Scallop PDT responded to this request by recommending that the Council close three areas by Interim Action during the 2000 scallop fishing year and consider closing a fourth through the annual framework adjustment, so that it coincides with the opening of the two closed areas in the Mid-Atlantic during the 2001 fishing year. The PDT recommends all four areas for closure based on the abundance of small scallops, the high amount of fishing effort within the proposed areas, and the potential for significant increases in yield if the NMFS enacts these closures. Closure of these areas will address

overfishing by delaying mortality on small scallops and increasing optimum yield in future years. The reason for the postponement for the fourth area is to provide sufficient areas to fish in the Mid-Atlantic, until the areas that are presently closed to re-open during the 2001 fishing year via Framework Adjustment 14.

The 2000 scallop research survey is presently underway and survey data is not yet available. The recommendations given below are therefore based on the presence of small scallops during the 1999 survey and one-year projections of biomass growth if these areas are not fished. The PDT consensus is that it would be desirable to close the recommended areas during the 2000 fishing year, but that it would be beneficial to have the 2000 survey data before taking final action.

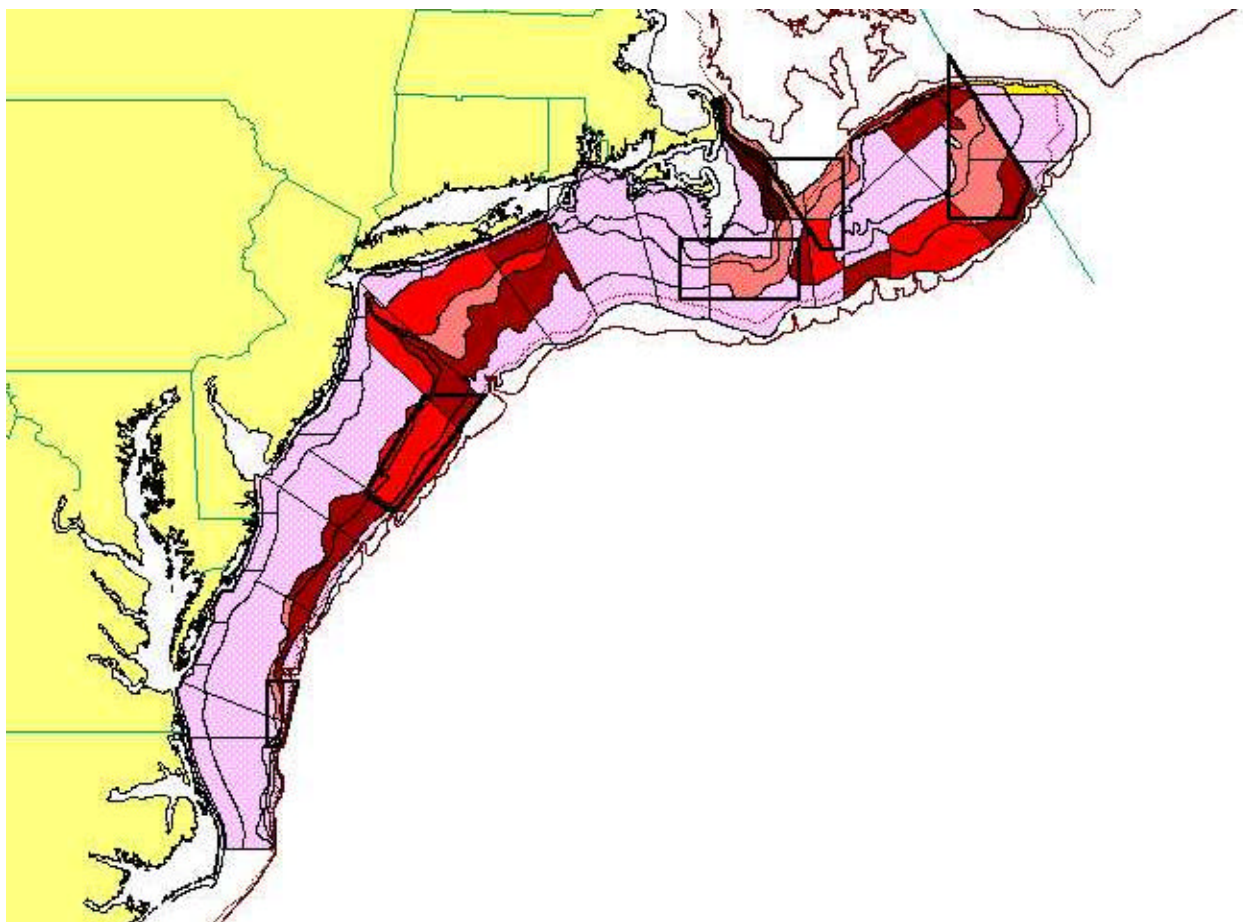
Future benefits from closing these areas will depend on the observed growth and mortality while closed and on the length of closure. In all cases, the benefits are expected to be positive by reducing mortality on small scallops, concentrating the fishing effort on larger scallops elsewhere.

**Recommendations for closure by Interim Action during the 2000 fishing year (see maps). These closures are recommended to remain in effect at least through all of the 2001 fishing year and should therefore be extended by Framework Adjustment 14.**

- Eastern Georges Bank: Between 40°30' and 41°30' N latitude and between 67°20' W longitude and the Canadian/US boundary. This area includes the southern portion of Closed Area II, which is currently open to fishing but scheduled to close on August 15, 2000. The 1999 scallop survey found significant amounts of small scallops in stratum 621, both inside and outside of Closed Area II. This boundary would extend the closure along the western edge of Closed Area II until it meets with the 100-fathom contour and thence east to the jurisdictional boundary with Canada.
- South Channel: Between 41°15' and 41°45' N latitude and between 69°15' and 69°45' W longitude. This boundary includes parts of strata 49-51, where small scallops were present, overlapping the NW corner of Closed Area I.
- Mid-Atlantic: Between 37° and 38° N latitude and east of 75° W longitude. This boundary includes strata 10, 11, and the southern part of strata 14 and 15, where small scallops were observed during the 2000 scallop survey.

**Recommendations for closure during the 2001 fishing year, via Framework Adjustment 14:**

- Mid-Atlantic: Between 39°30' N and 40°30' N latitude and between 72° and 73°45' W longitude. This boundary includes stratum 26 where a significant amount of small scallops were observed during the 1999 scallop survey.
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**Figure 46.** Estimated potential for biomass growth (darker shading represents greatest one-year potential<sup>60</sup>) by survey stratum, based on observed length frequencies observed by the 1999 research survey.

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<sup>60</sup> Categories:

0

>0 to 32.5 percent

32.5 to 50.6 percent

50.6 to 89.1 percent

89.1 to 222.6 percent