Summary of sea scallop benchmark assessment for 2009 (SARC-50)

Updated assessment for 2010

Calculation of sea scallop ABC for 2011 and 2012

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Sea Scallop Benchmark Assessment

Main terms of reference

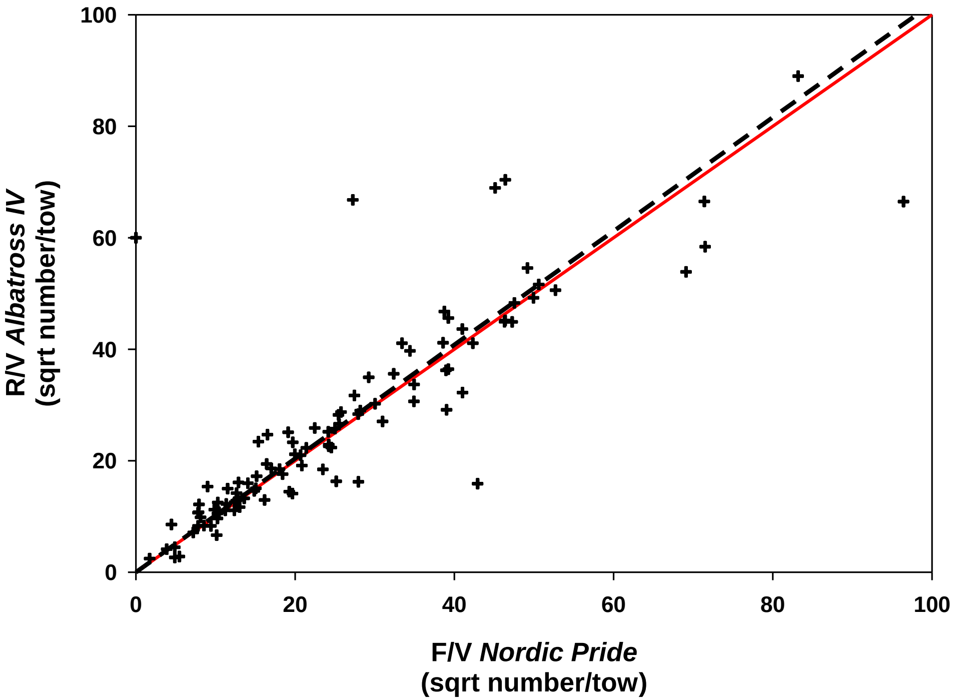
1. Surveys, especially survey calibration
2. Estimation of sea scallop biomass and fishing mortality for 2009 and previous years
3. Estimation of reference points (FMSY and BMSY)
4. Forecasting methodology

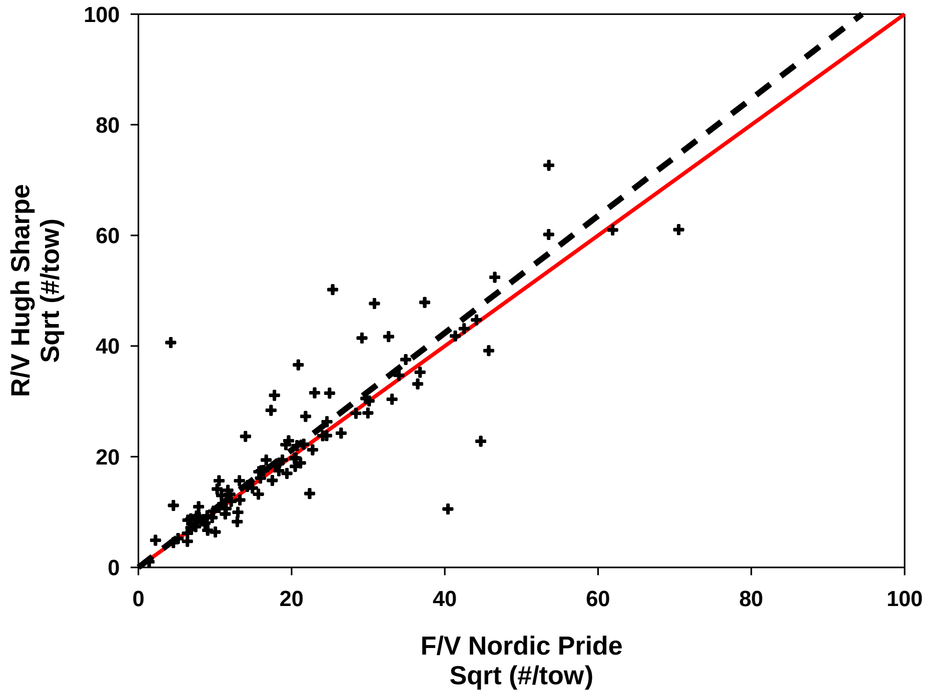
The NEFSC sea scallop survey was conducted (except for 1990-1992) through 2007 on the *R/V Albatross IV*. Since 2008, it has been conducted on the *R/V Hugh Sharp*. The *Sharp* uses a slightly redesigned dredge

The *R/V Albatross IV* was calibrated in 2007 with a commercial fishing vessel, the *F/V Nordic Pride*. *R/V Hugh Sharp* was compared to *F/V Nordic Pride* in 2009

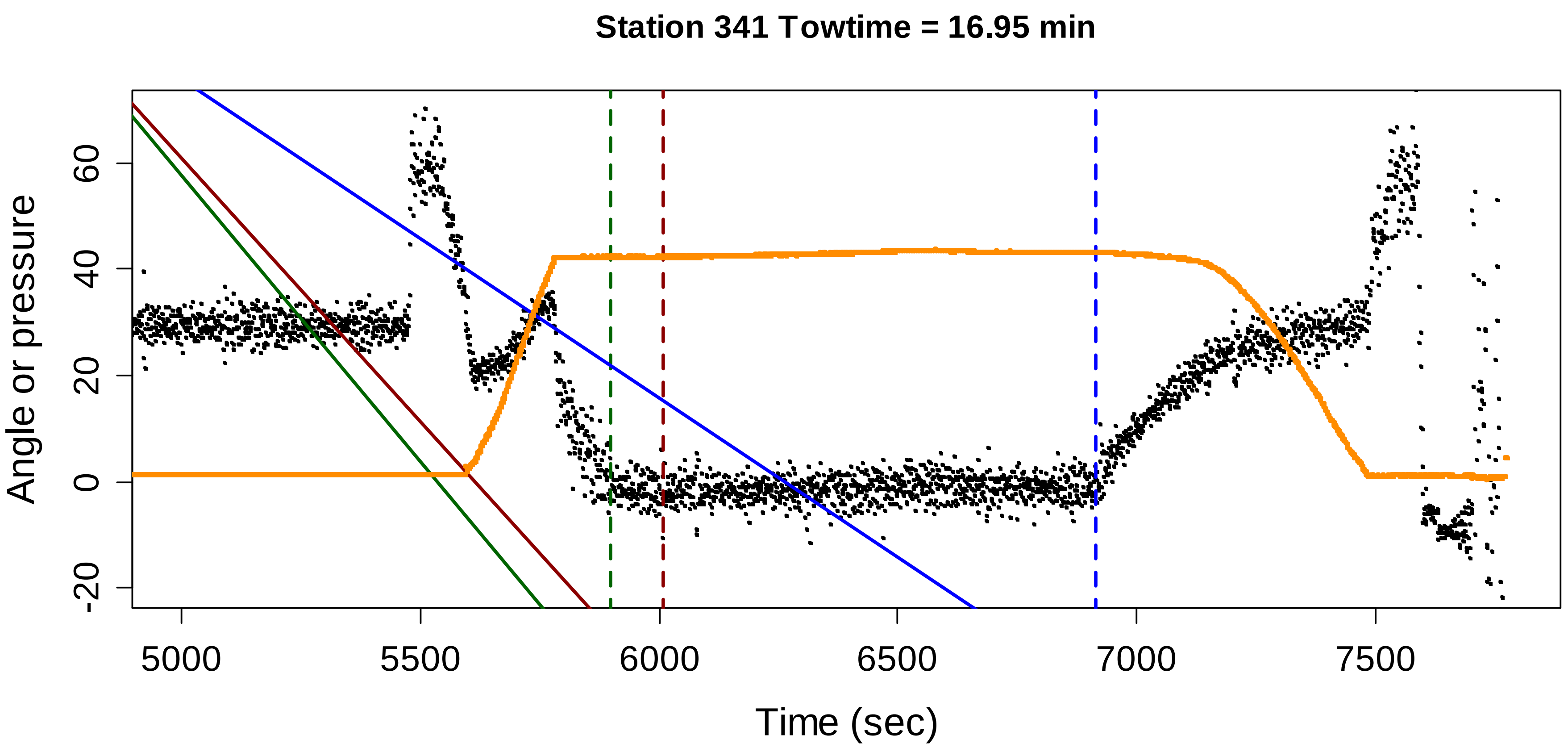
The comparisons suggest slightly greater catches on the *Sharp* than the *Albatross IV* or *Nordic Pride* (Appendix 4 – D. Rudders et al VIMS)

1-1 line indicated in red





Analysis of dredge sensor data indicate that dredges on the *Sharp* fish for longer than their nominal tow time, and have about a 5% longer tow path than that of the *Albatross IV.* This, combined with the calibration with the *Nordic Pride*, suggest a 5% downward adjustment for *Sharp* catches.



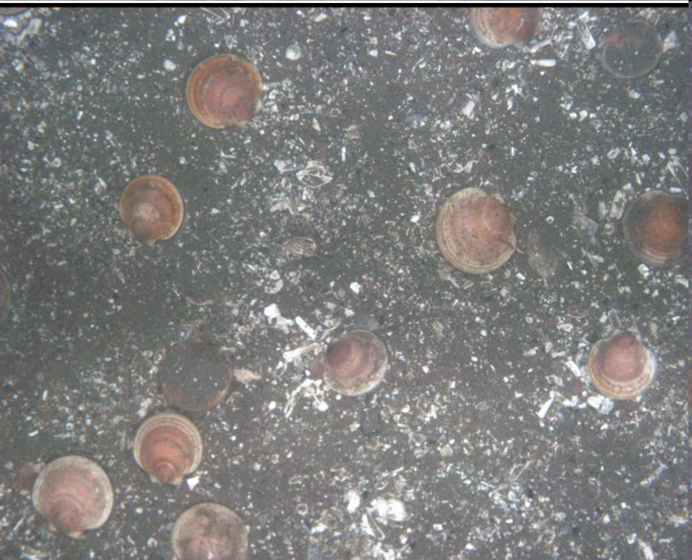
140 paired tows between survey dredge and HabCam towed camera system (Appendix 10)

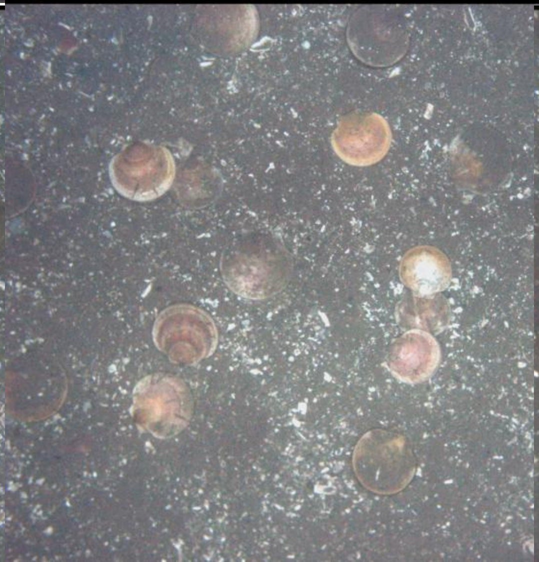
Estimated efficiency:

0.38 (hard bottom)

0.44 (soft bottom)

Commercial dredges are 30-40% more efficient on large scallops



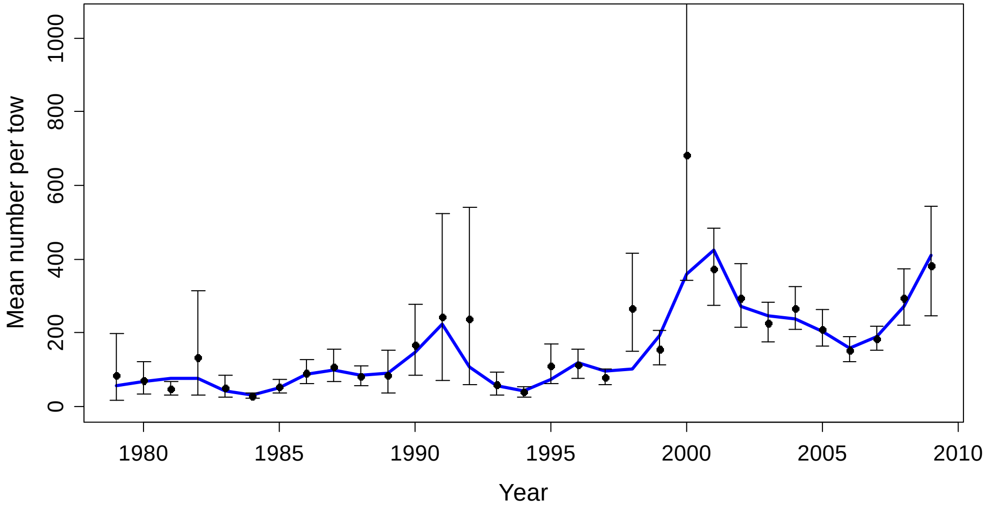


Other survey issues discussed:

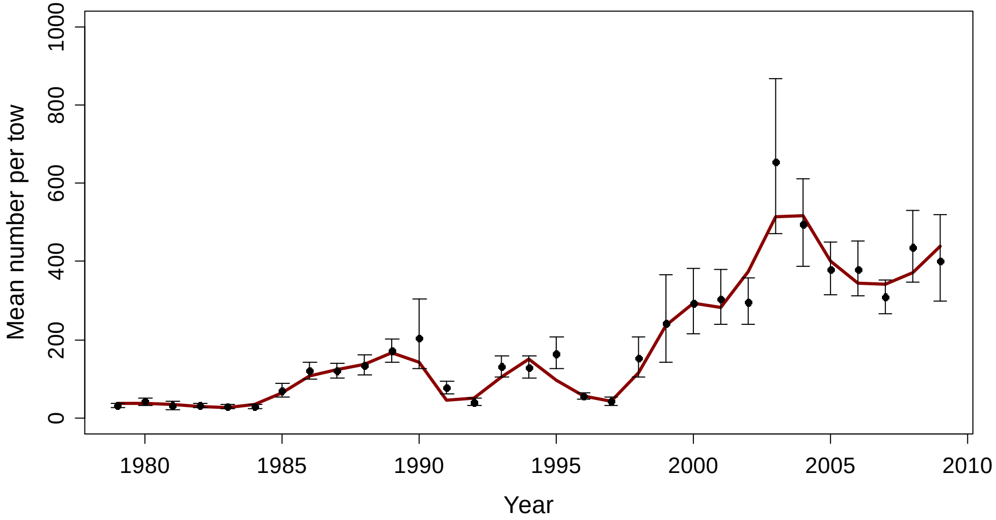
Fraction of scallop biomass missed by standard scallop survey strata
~10% in Mid-Atlantic and 3% on Georges Bank

Edge effects on SMAST survey

NEFSC dredge survey abundance

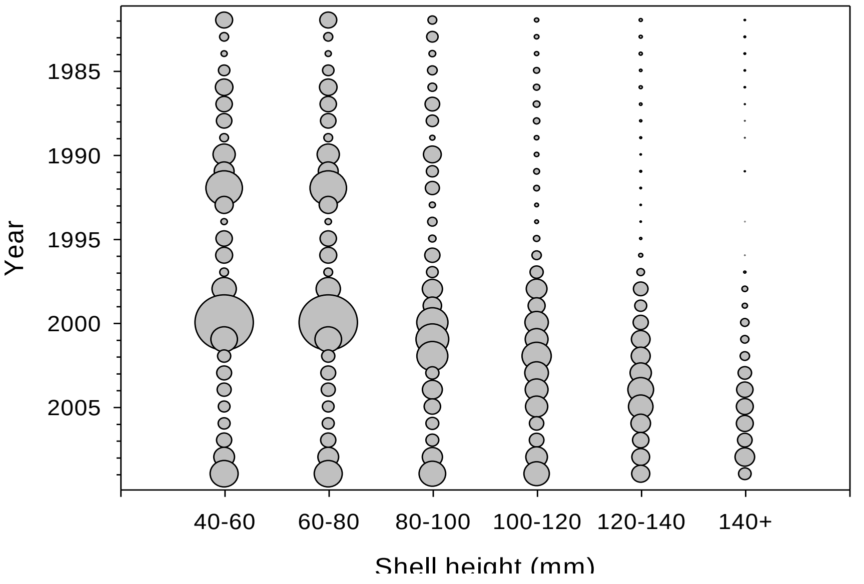


Georges Bank

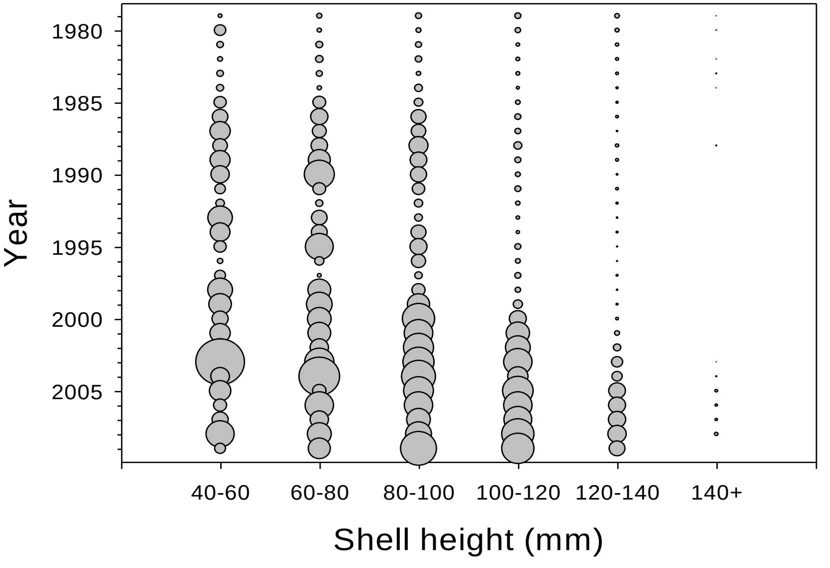


Mid-Atlantic

NEFSC dredge survey shell



Georges Bank



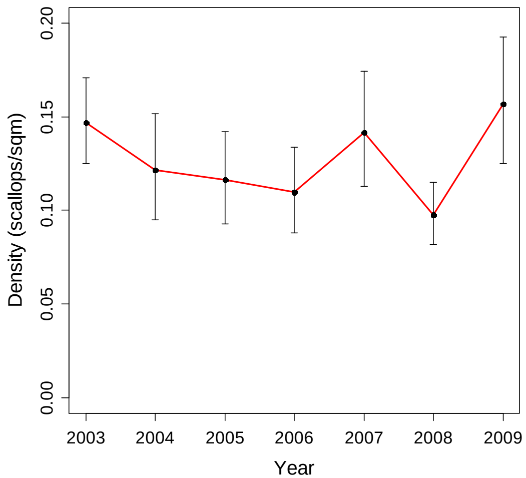
Mid-Atlantic

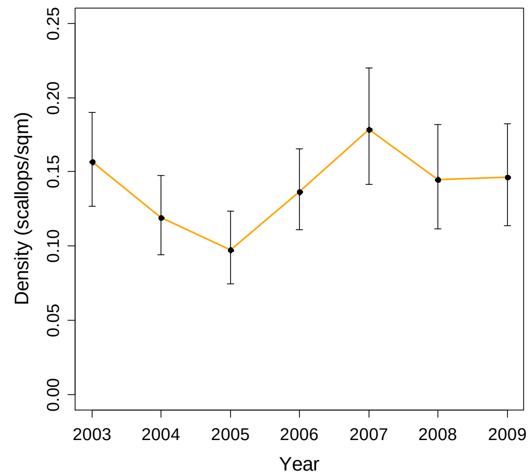
SMAST Survey

Large Camera

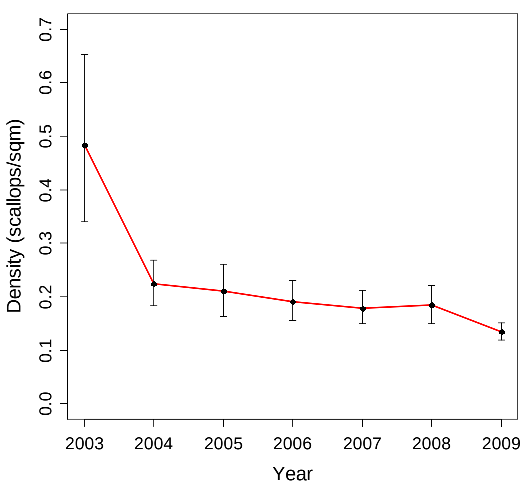
Small Camera

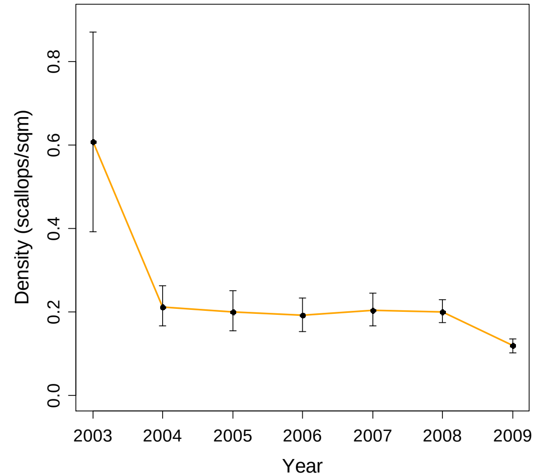
Georges Bank





Mid-Atlantic





Estimation of sea scallop biomass and fishing mortality for 2009 and previous years

Like the last assessment, a statistical catch-at-size model (CASA) was employed

Inputs: Surveys, landings, commercial shell heights and meat weights (from observers), growth increments from shell ring analysis

Outputs: Estimates of fishing mortality and selectivity, biomass and abundance etc

Some changes in estimates of life history parameters

New estimates: M = 0.12 (Georges Bank), M = 0.15 (Mid-Atlantic), compared to previous estimates of M = 0.1 in both regions

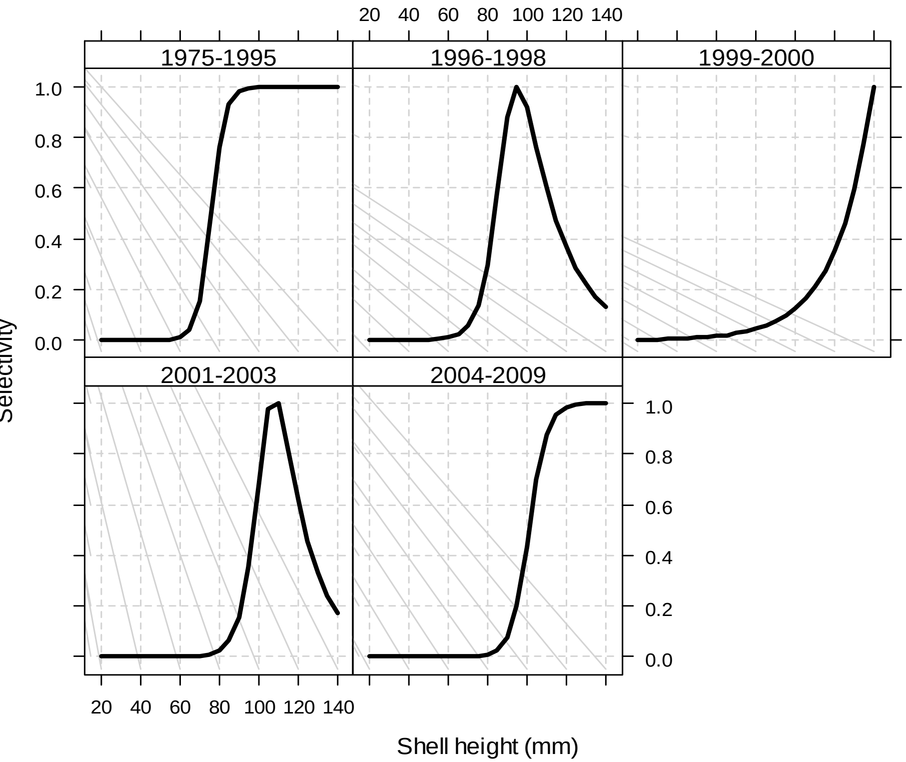
Incidental mortality increased to 0.2 (Georges Bank) and 0.1 (Mid-Atlantic) of fully-recruited fishing mortality (compared to 0.15 and 0.04 previously).

The new assumptions reduce the productivity potential of the stock, and likely will result in less (over) optimistic projections.

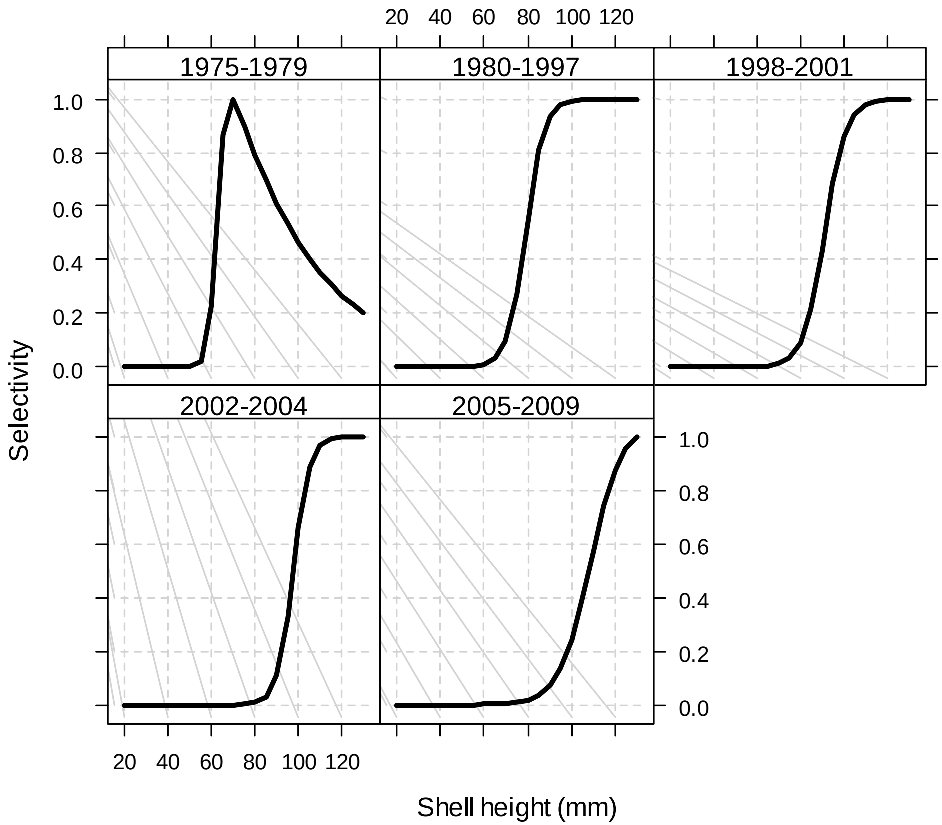
Fishery selectivity continues to shift towards larger scallops

(Full) fishing mortality estimates only apply to largest (fully recruited, currently 130+ mm) sizes.

Georges Bank

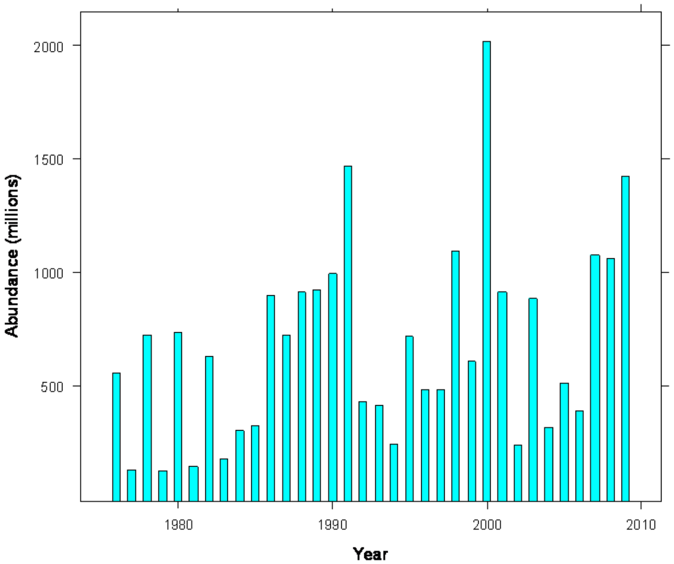


Mid-Atlantic

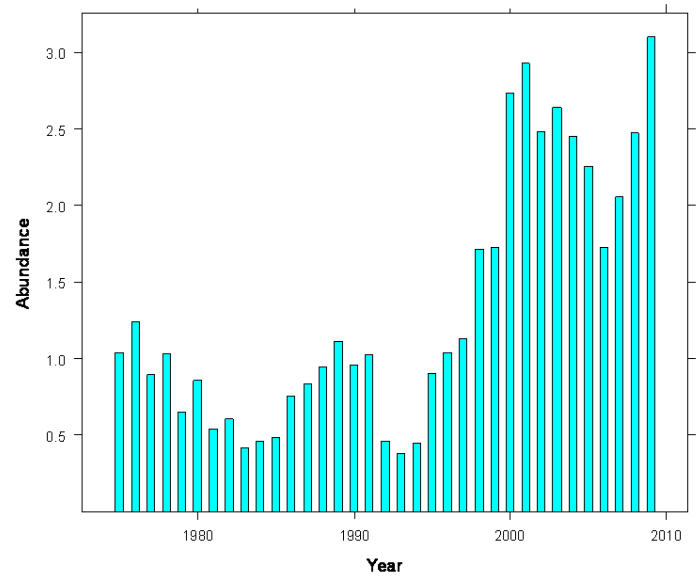


Georges Bank

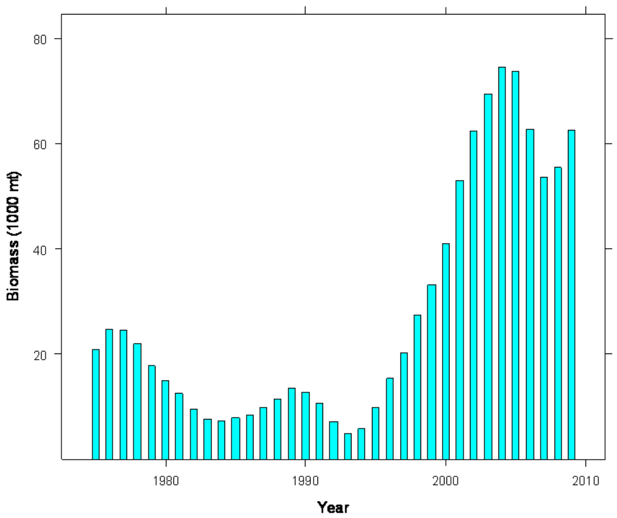
Recruitment



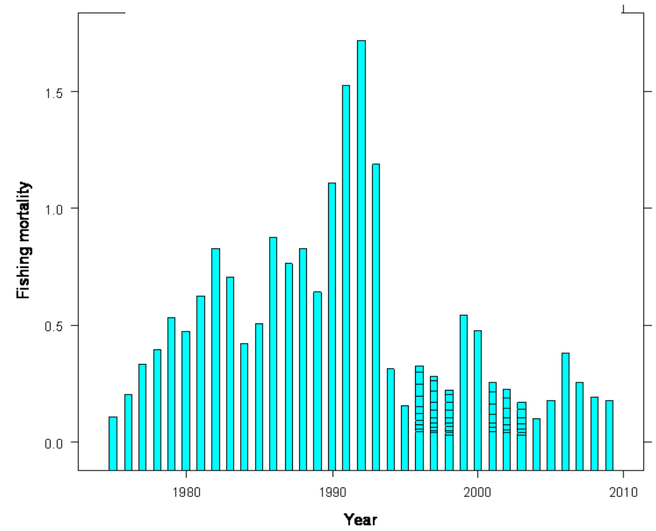
Abundance 40+

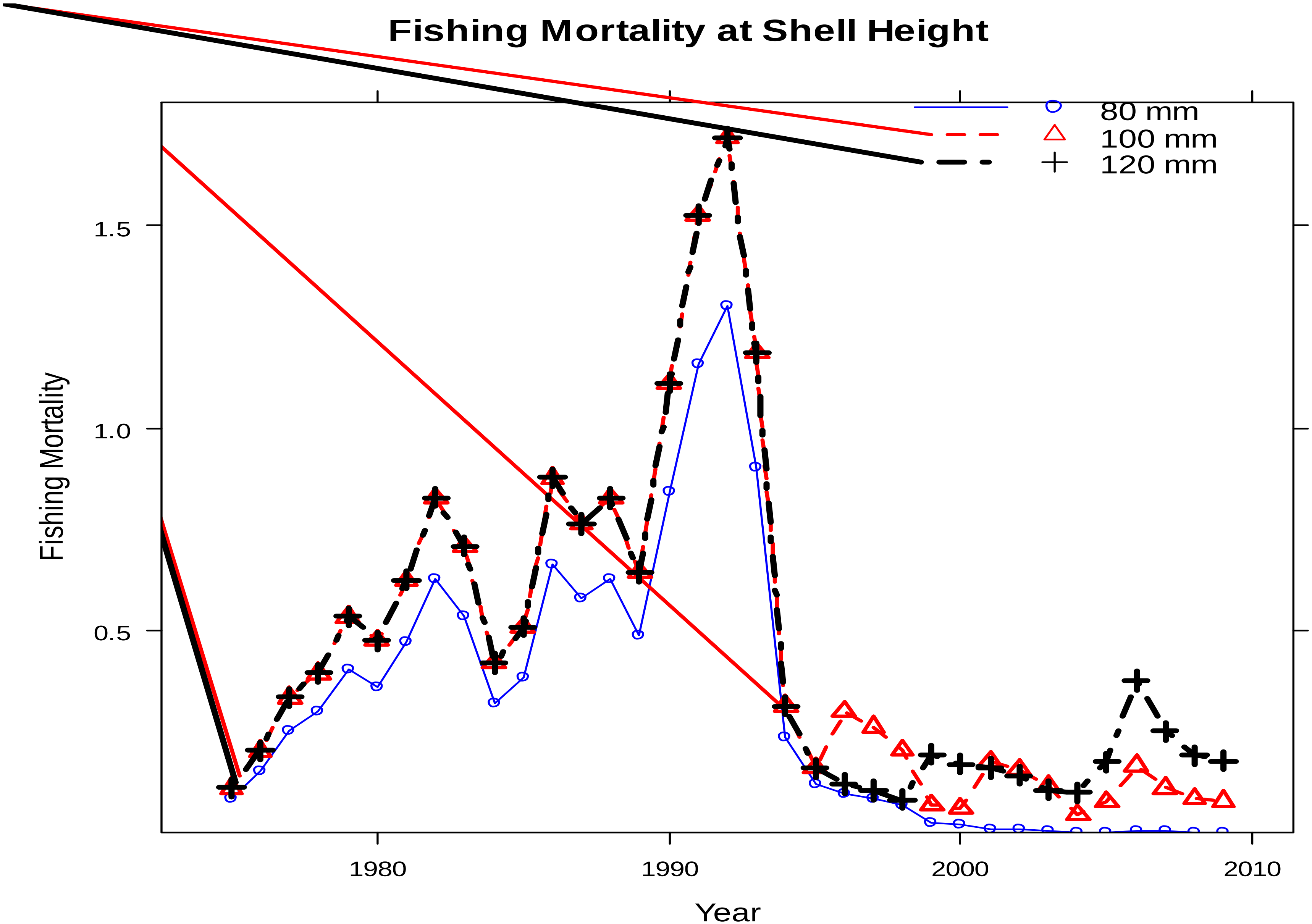


Biomass



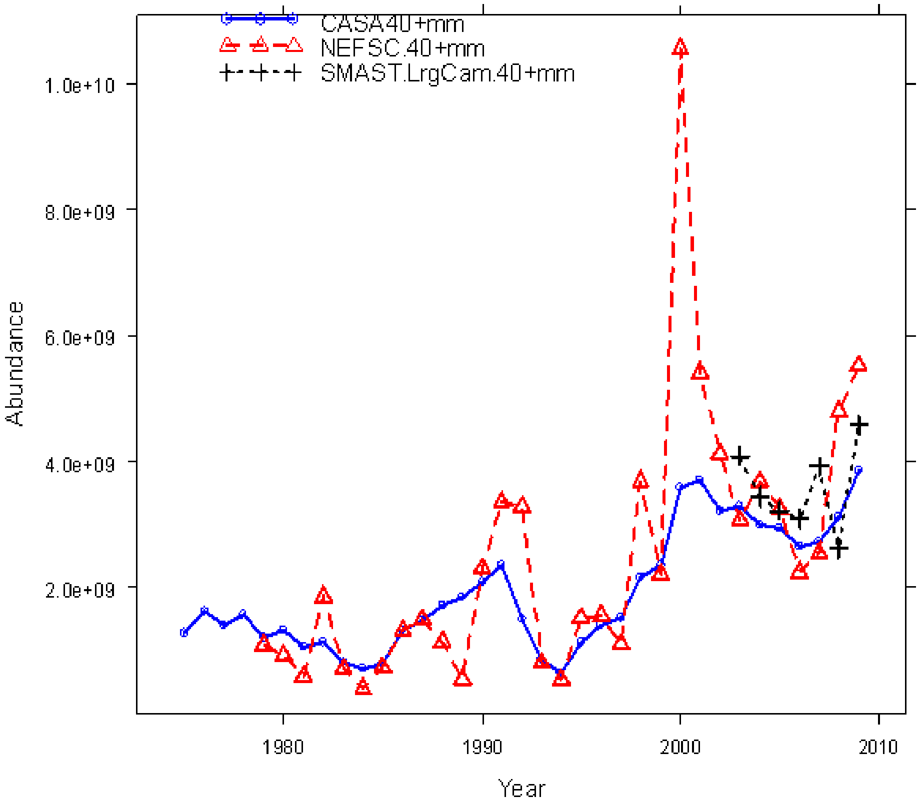
Fishing mortality

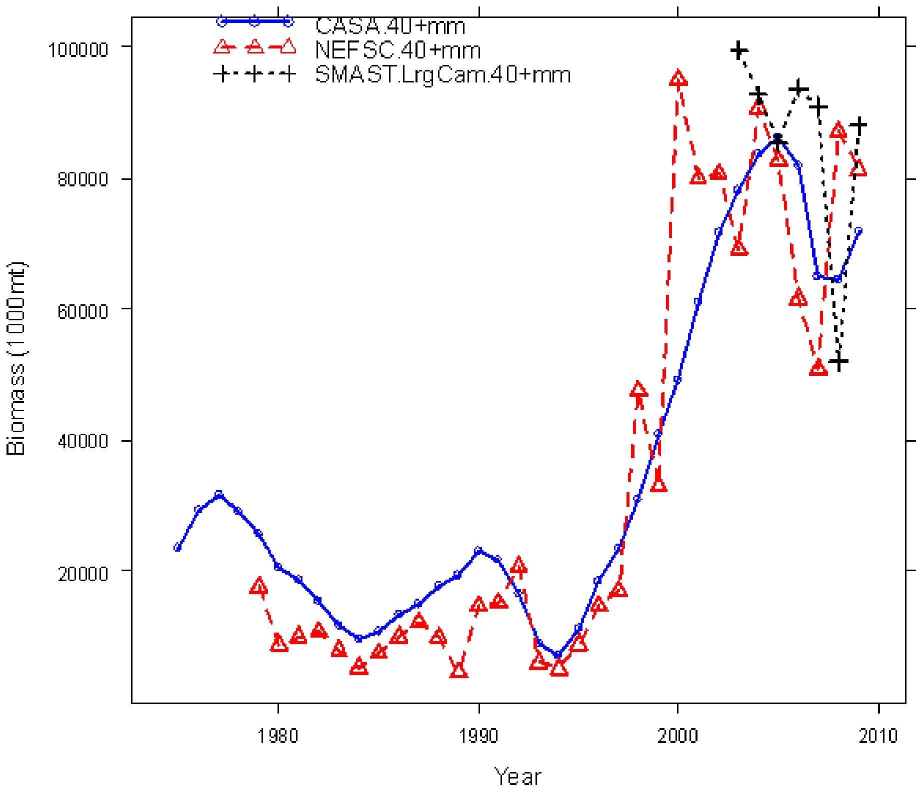




Fishing Mortality at Shell Height
80 mm
100 mm
120 mm
1.5
1.0
0.5
Fishing Mortality
1980
1990
2000
2010
Year

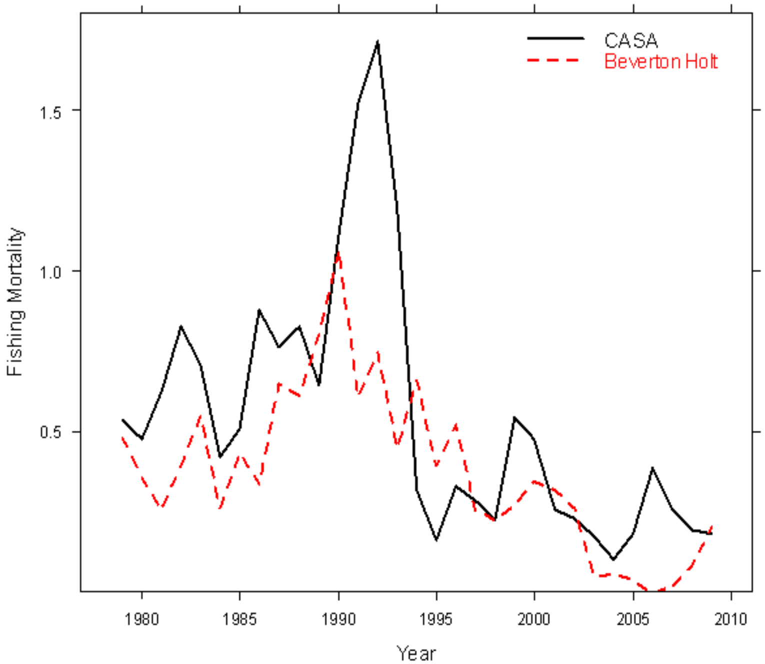
Comparison of model abundance and biomass estimates to survey estimates



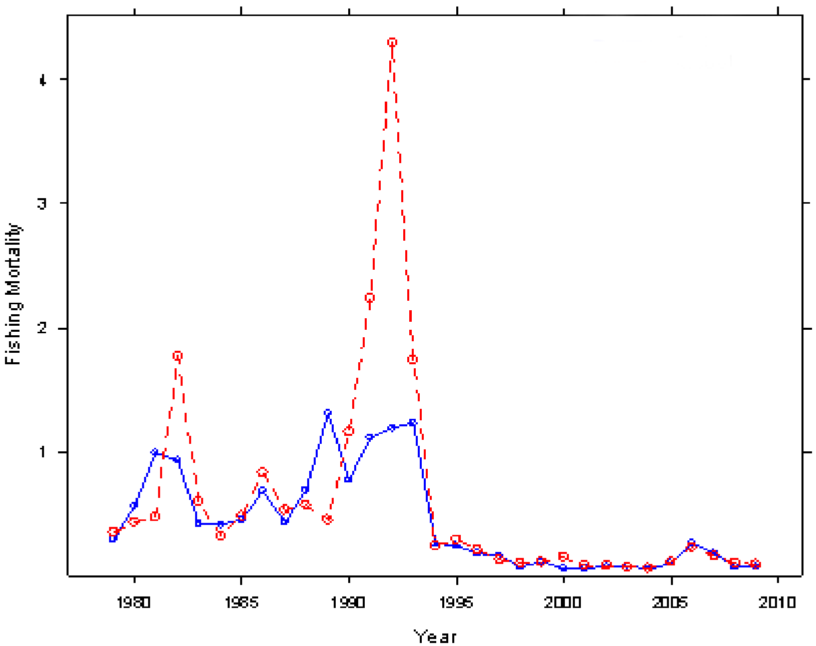


Comparison of model estimates of fishing mortality/exploitation to simple empirical models

CASA vs Beverton-Holt equilibrium length-based estimator

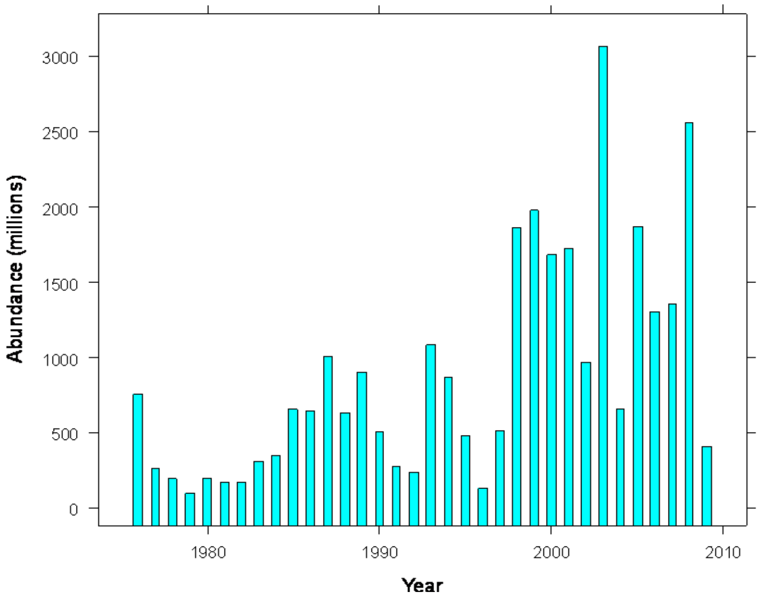


Exploitation indices
caught/population > 80 mm



Mid-Atlantic

Recruitment



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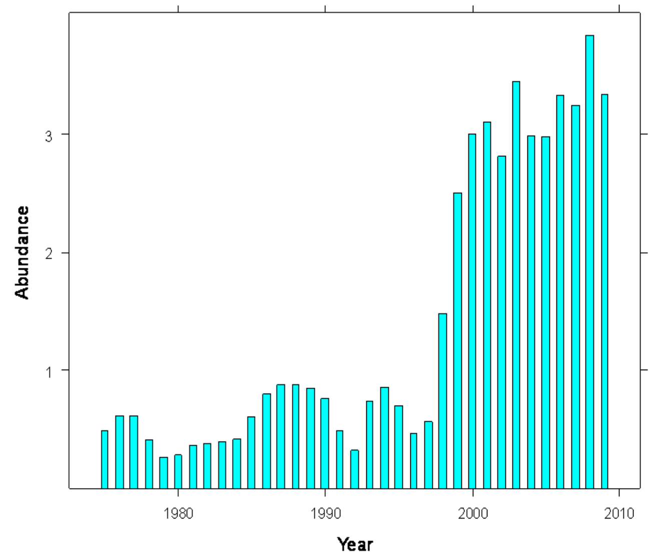
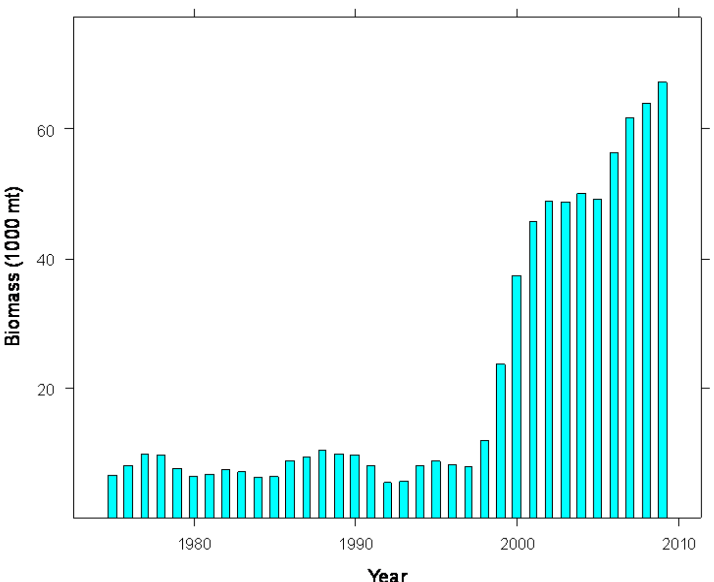
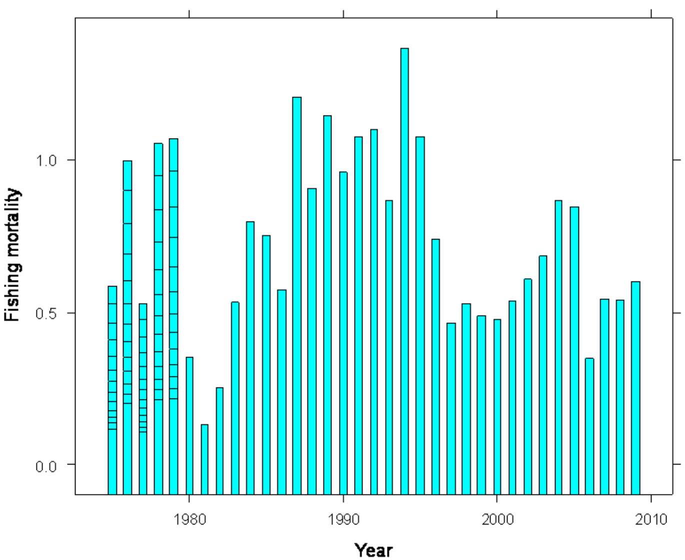


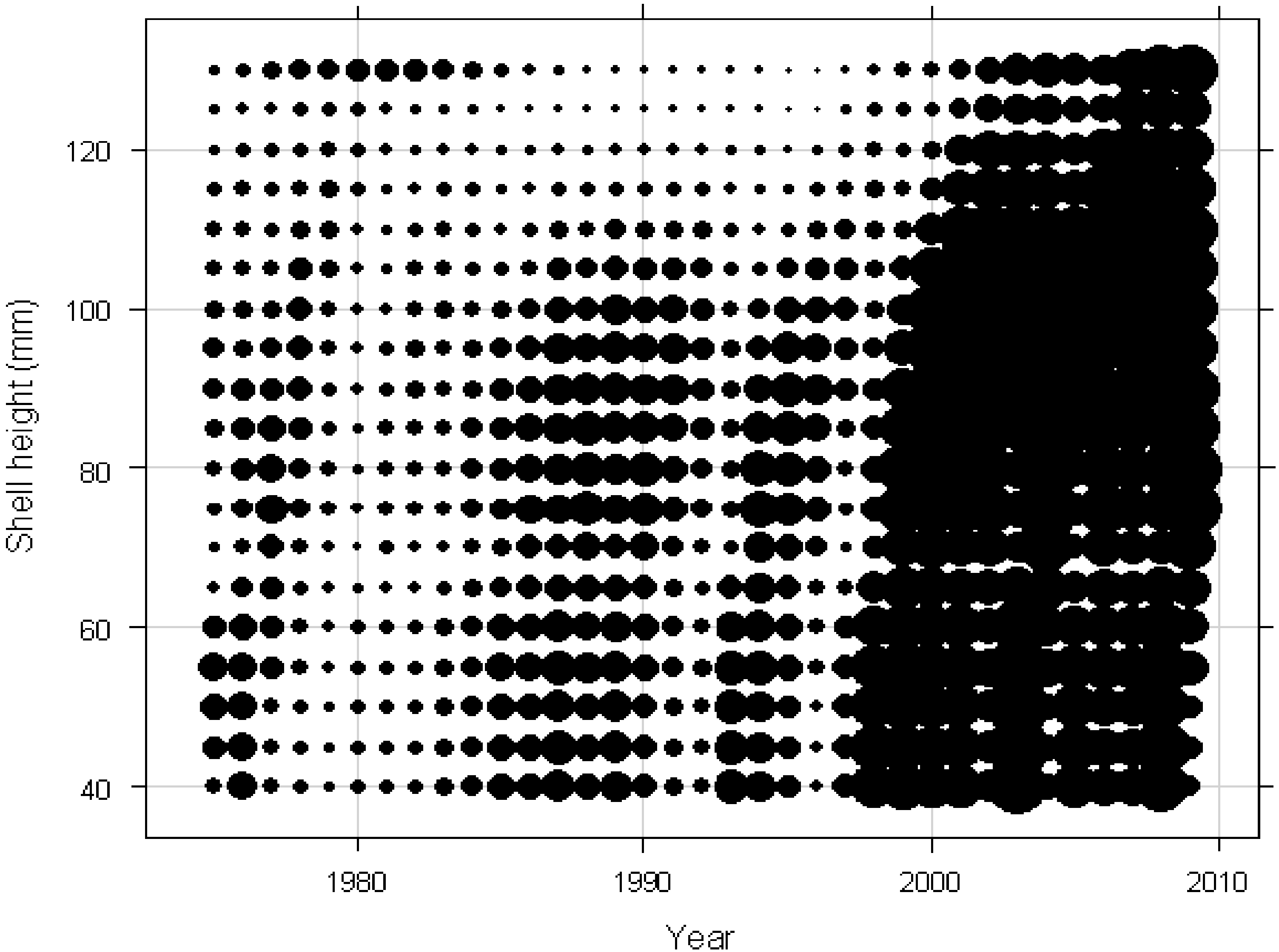
Biomass



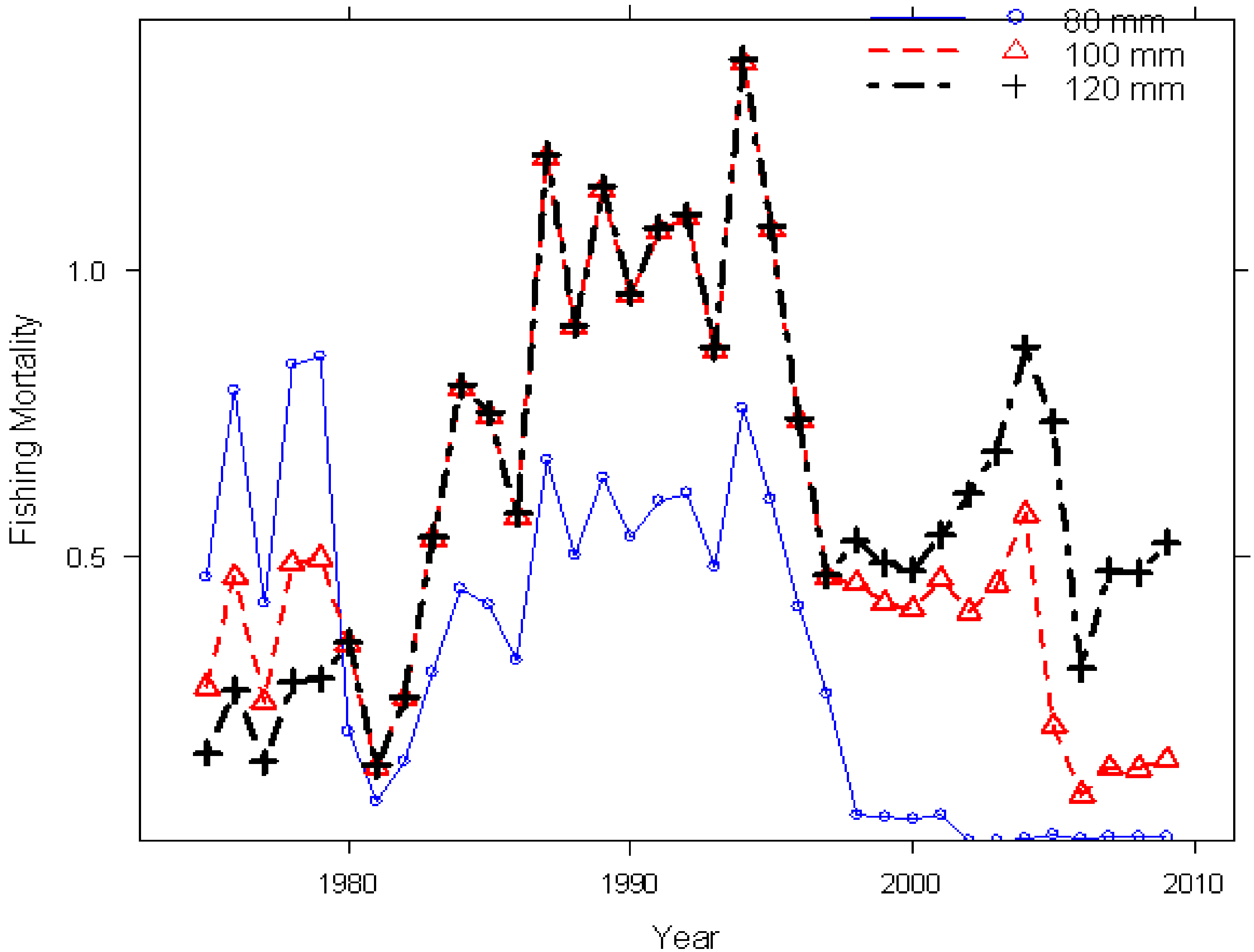
Fishing mortality



Number at shell height



Fishing mortality at 80, 100, 120 mm SH



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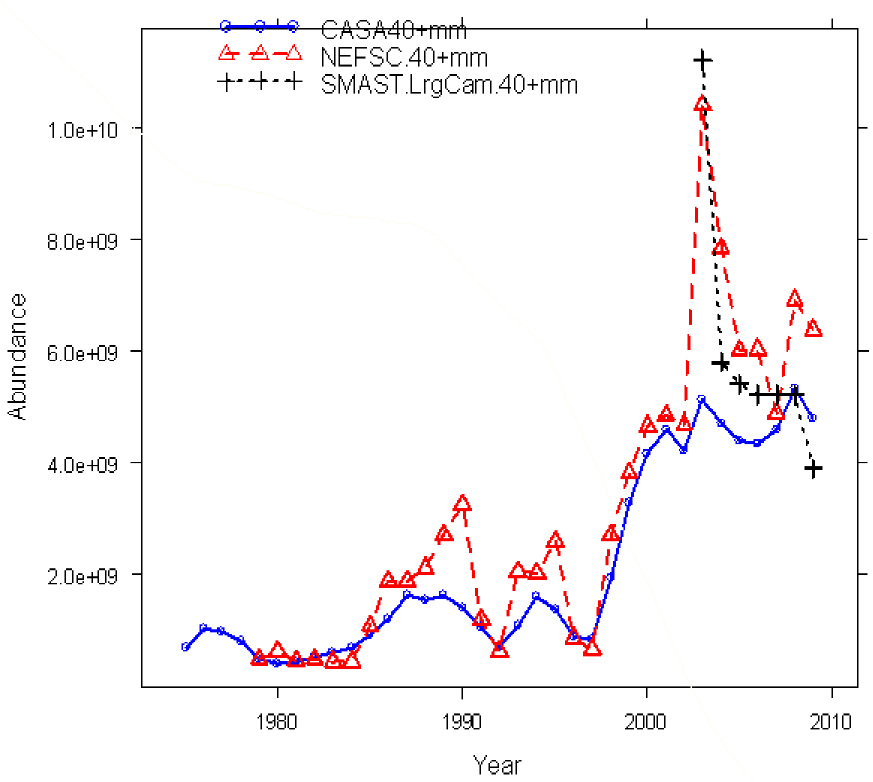

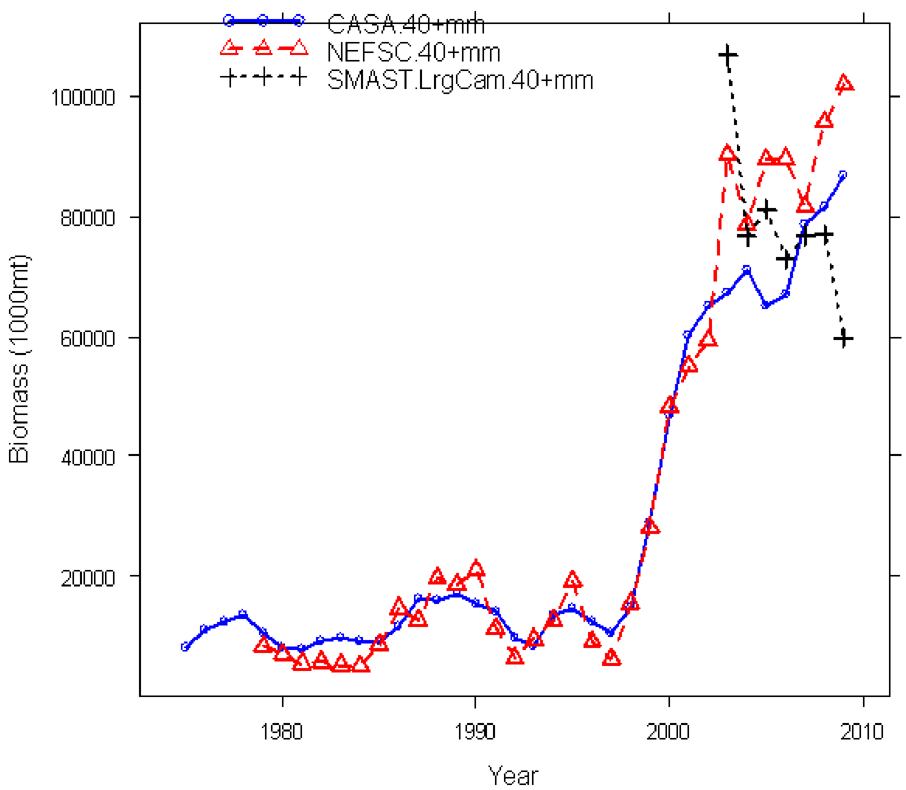

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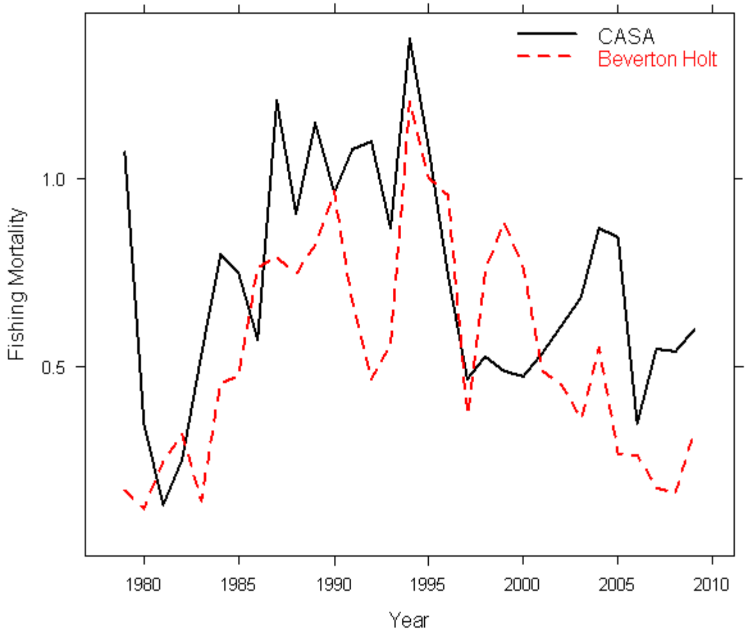
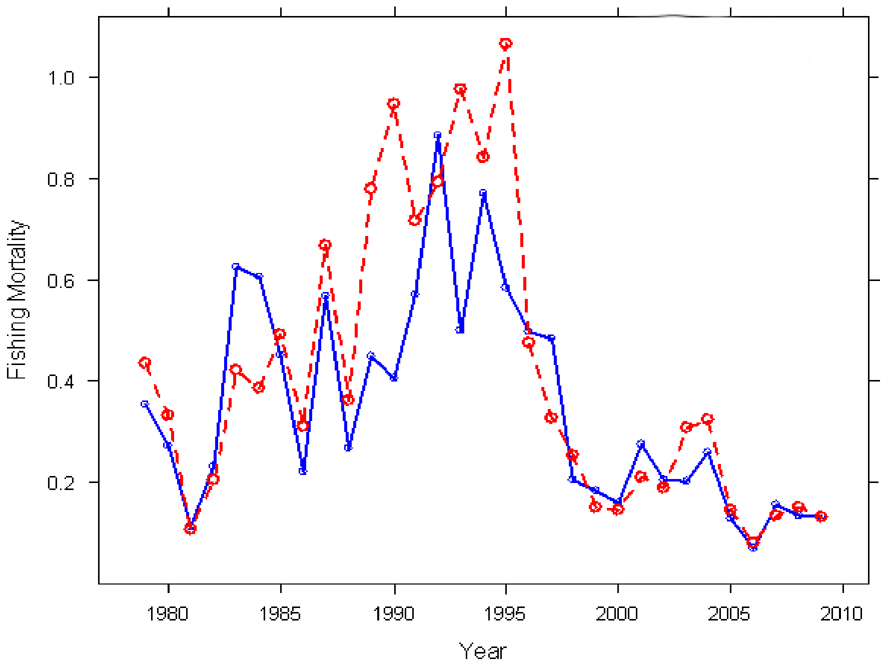
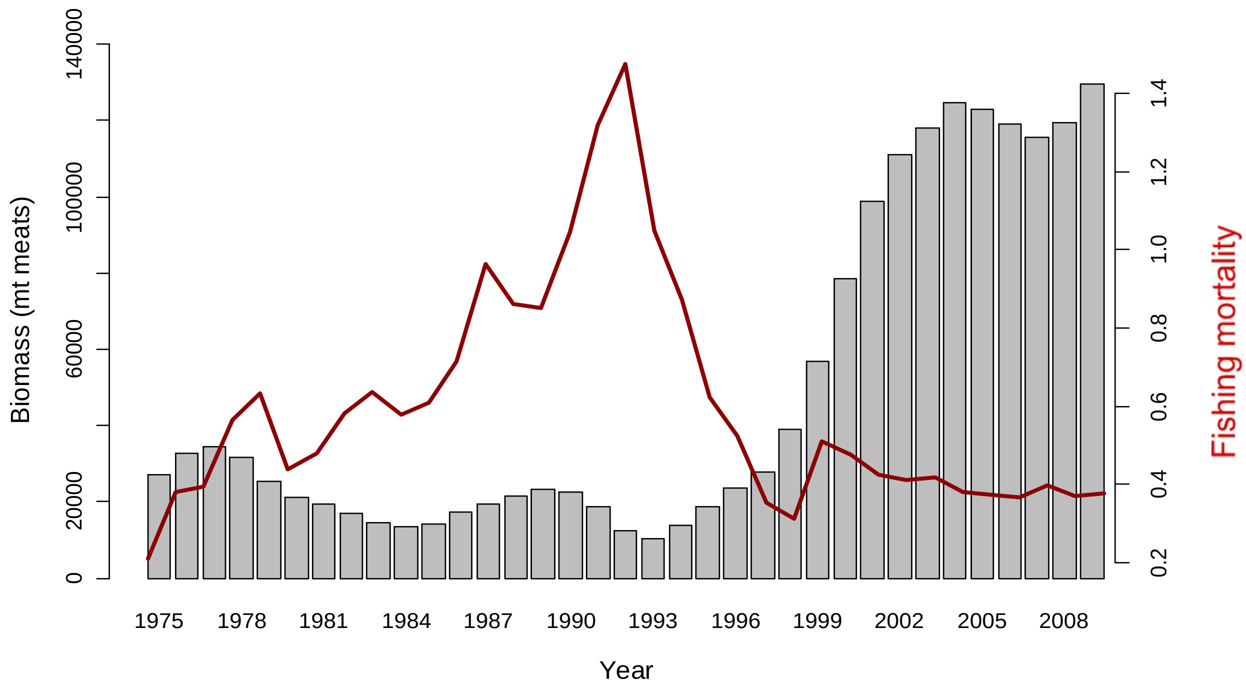






2009 Estimates

Region	Full F	Abundance millions	Biomass mt meats
Georges Bank	0.18	3453	62,470
Mid-Atlantic	0.60	3993	67,233
Combined	**0.38**	**7446**	**129,703**

Reference points (SYM model)

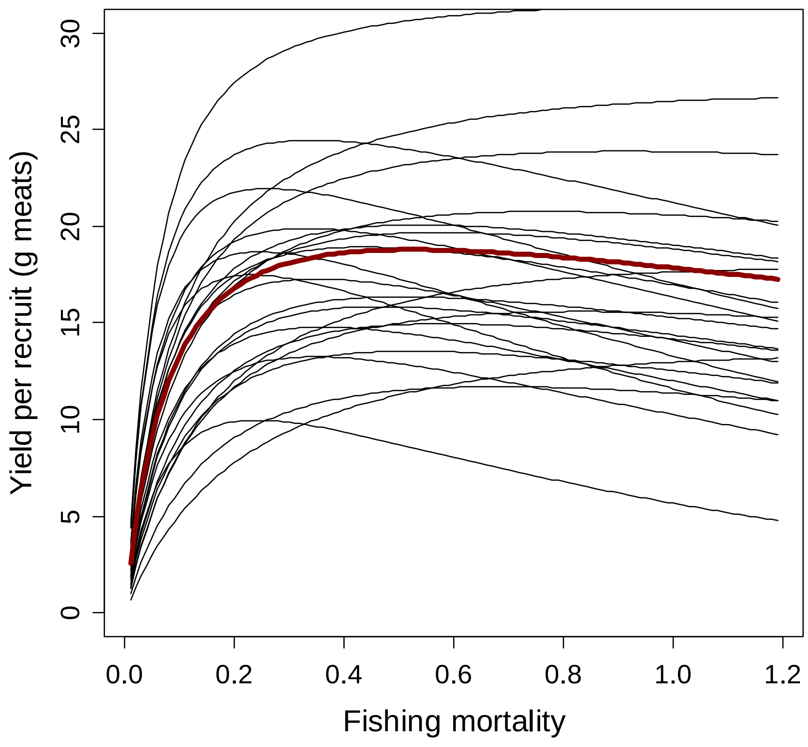
Previous assessments estimated proxy per recruit reference points

This assessment introduced a new stochastic yield model, which takes into account uncertainties in input parameters to per recruit and stock-recruit calculations to obtain estimates of MSY, FMSY and BMSY together with their uncertainties

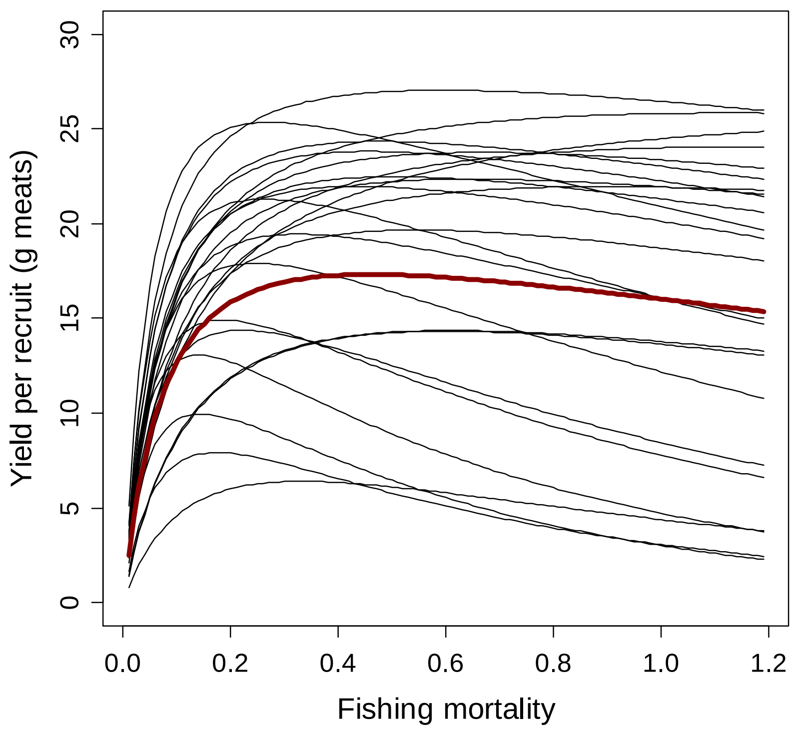
25 example YPR curves constructed by Monte-Carlo simulation

Red line is mean (expected) YPR

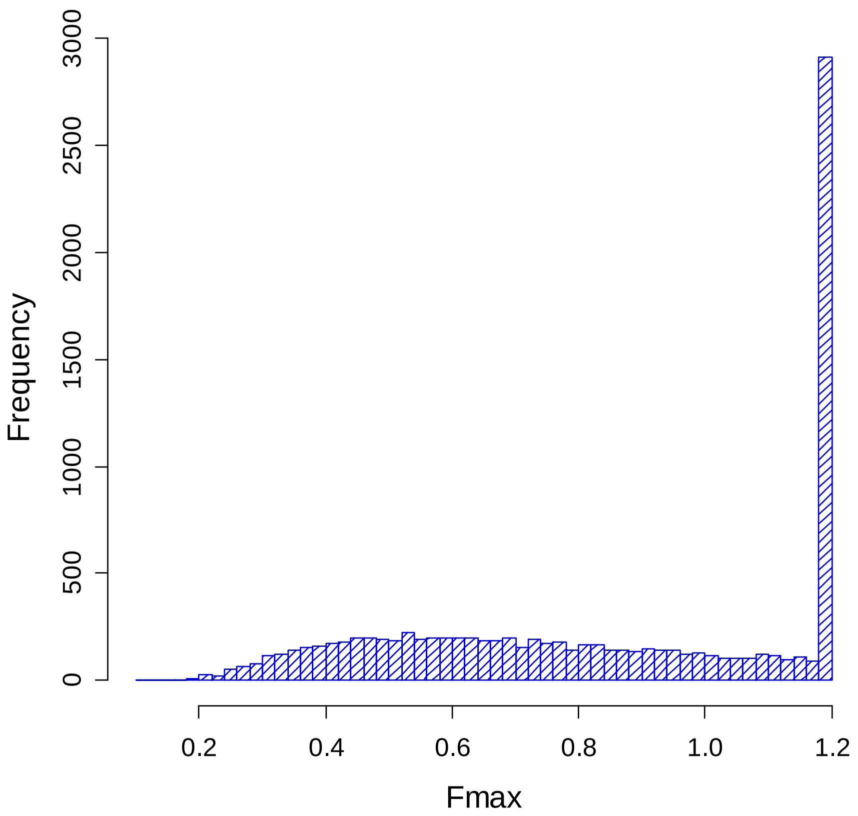
Mid-Atlantic



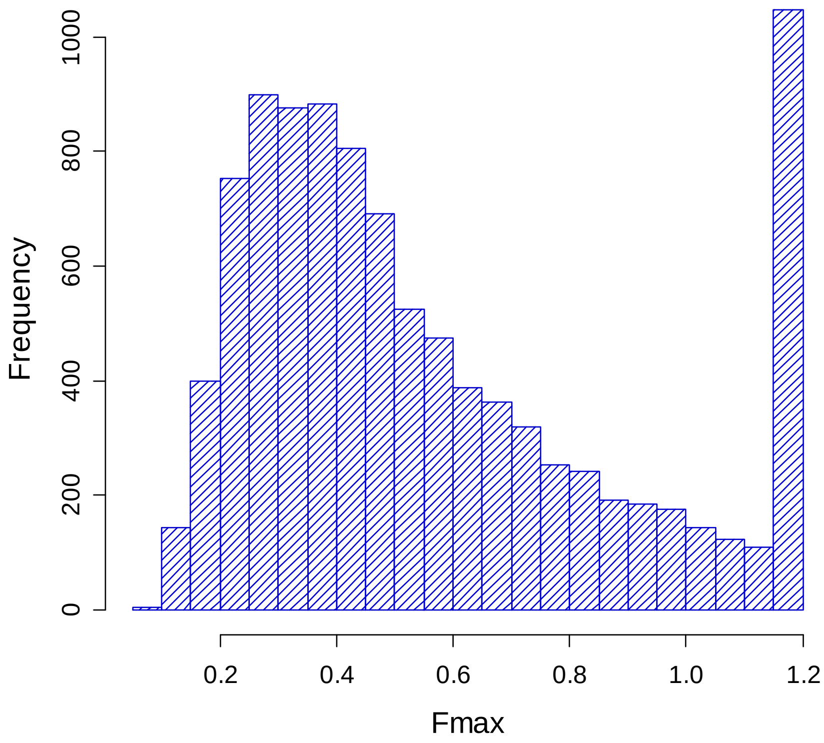
Georges Bank



Mid-Atlantic

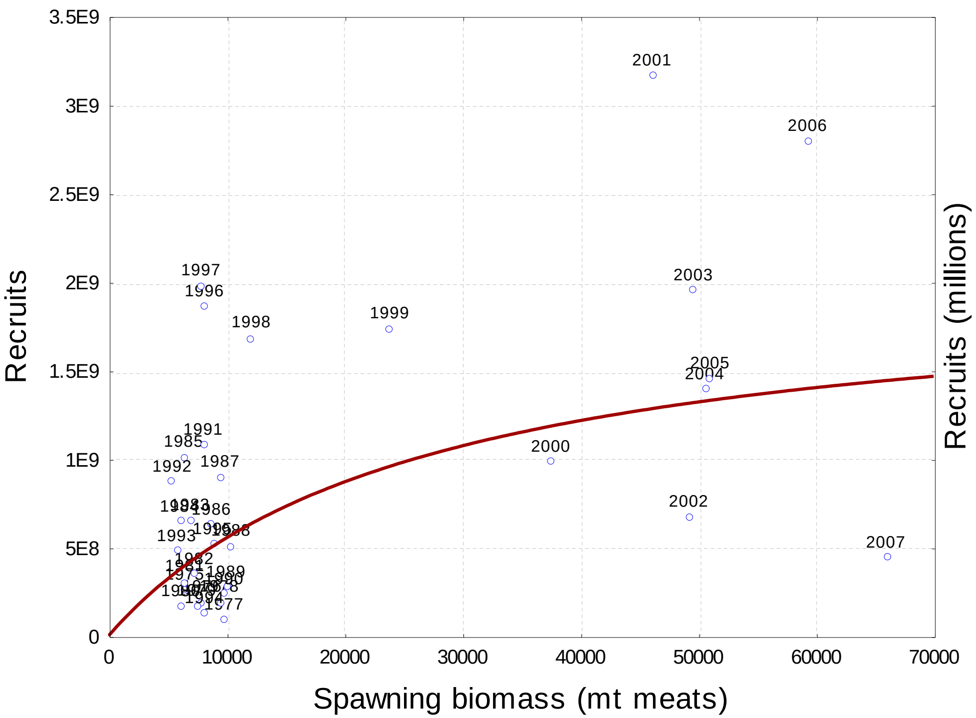


Georges Bank

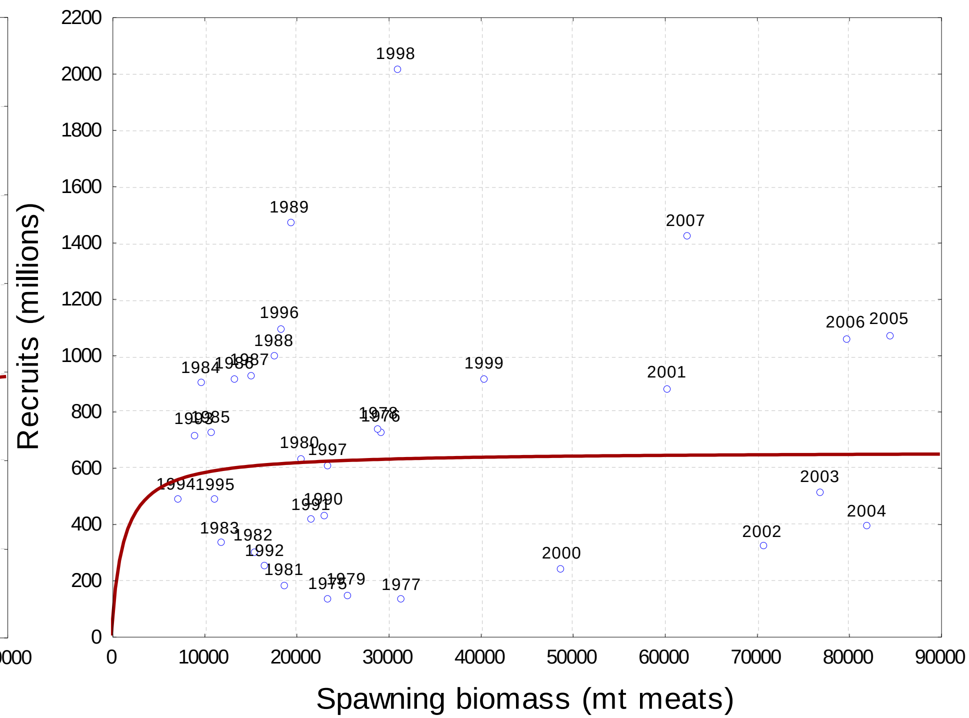


Deterministic spawner-recruit relationships

Mid-Atlantic

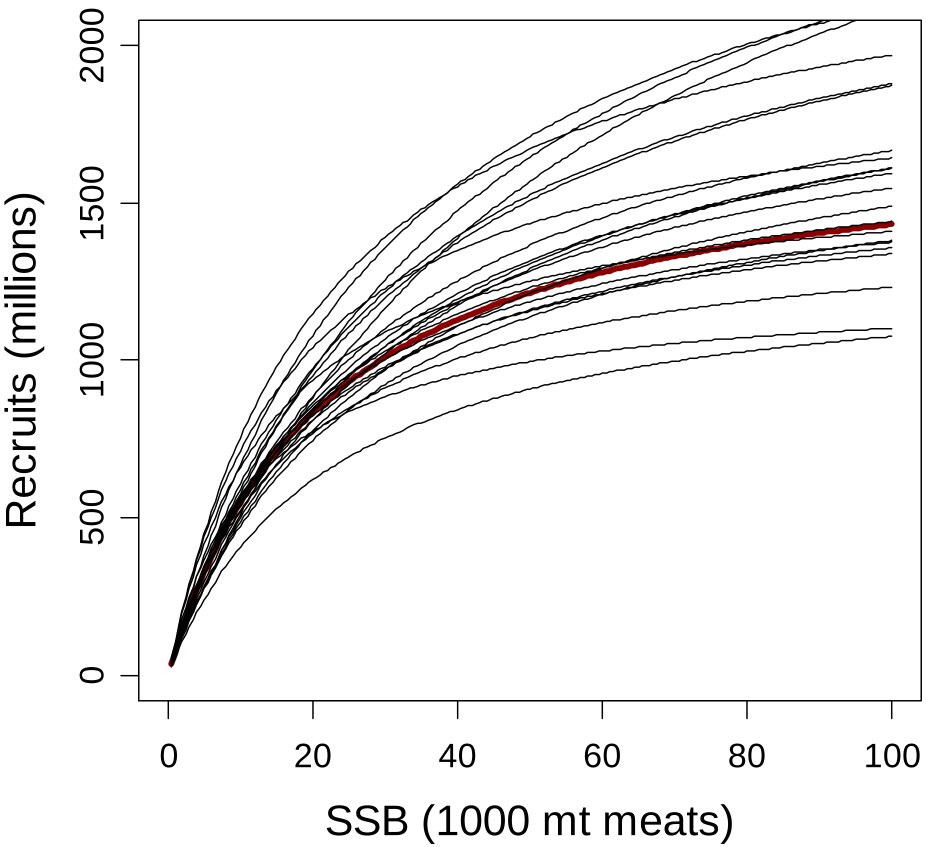


Georges Bank

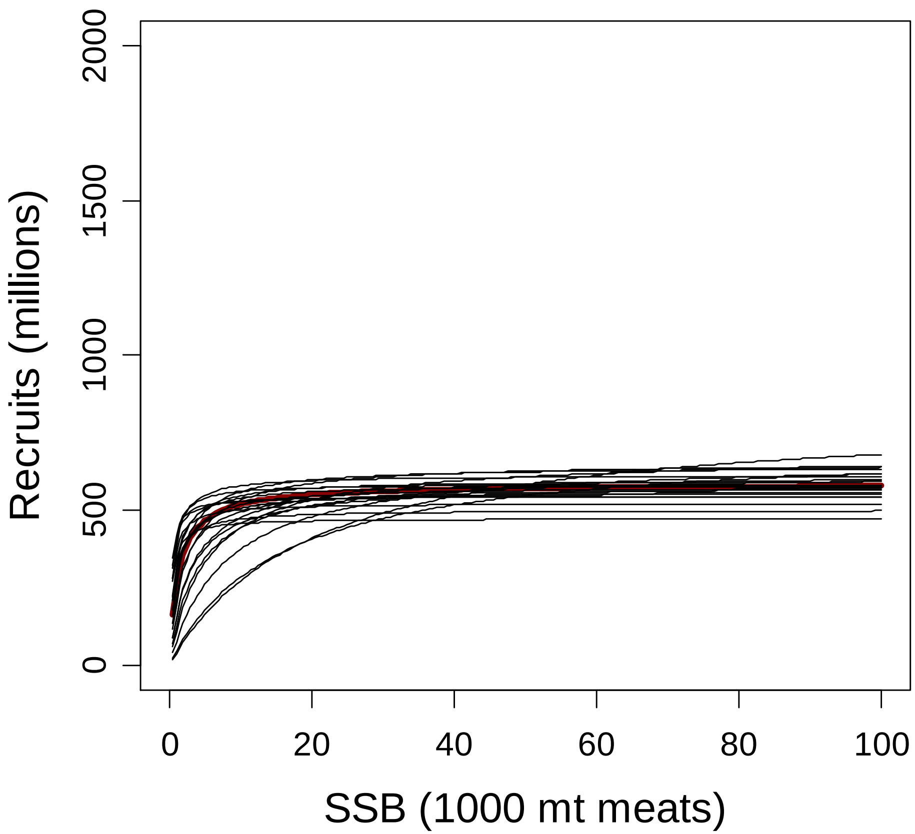


Stochastic stock-recruit curves

Mid-Atlantic

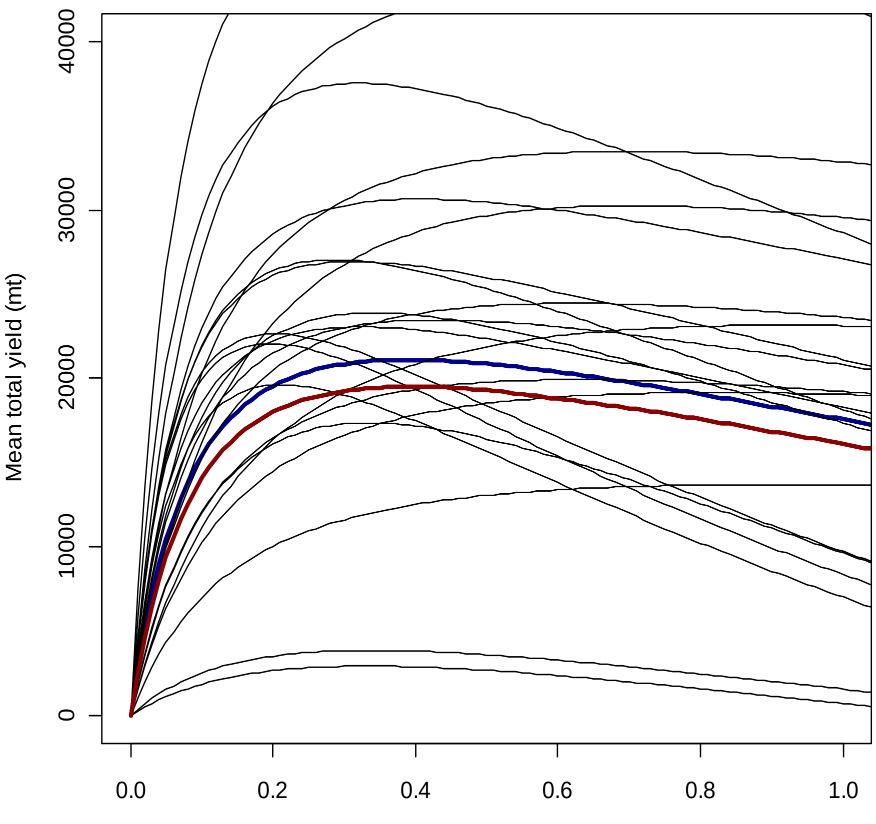


Georges Bank

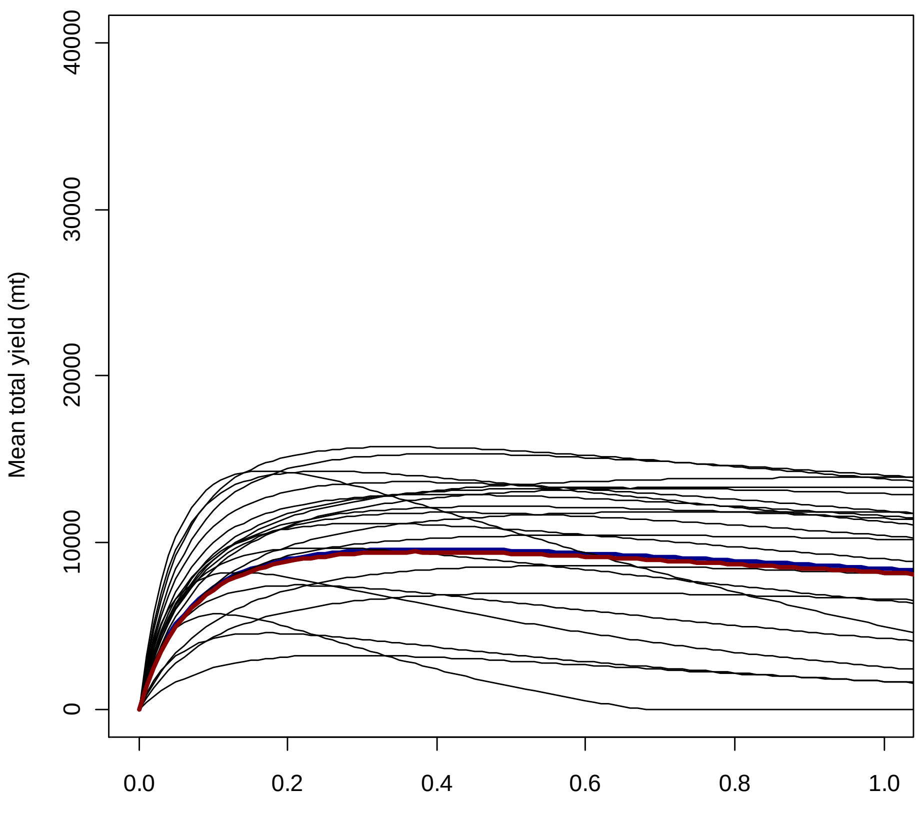


Stochastic yield curves

Mid-Atlantic

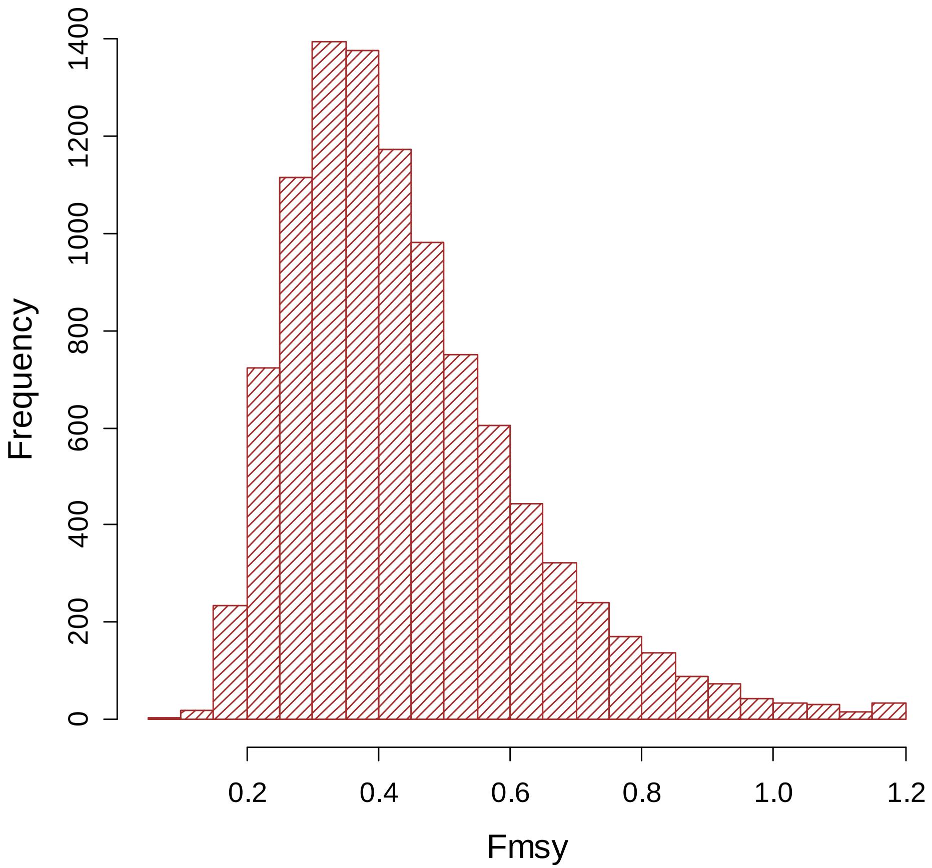


Georges Bank

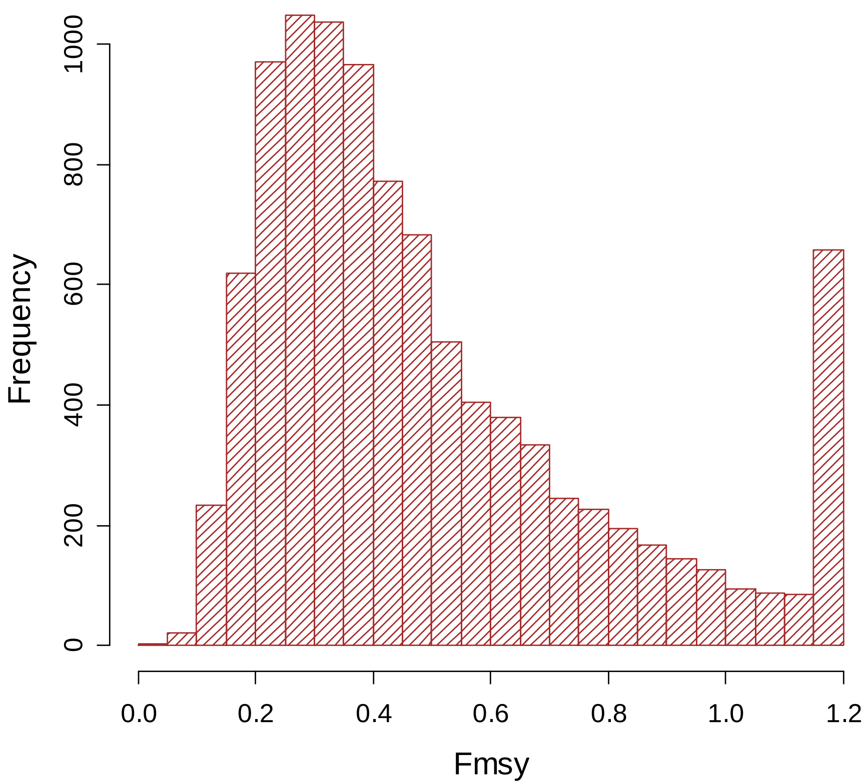


Distributions of F_{MSY}

Mid-Atlantic

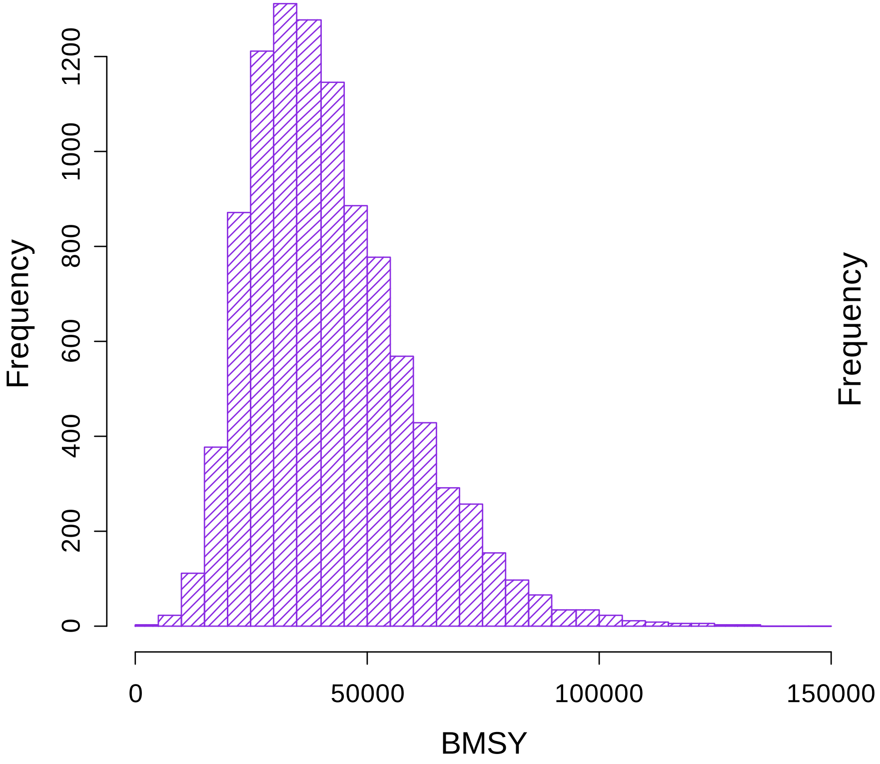


Georges Bank

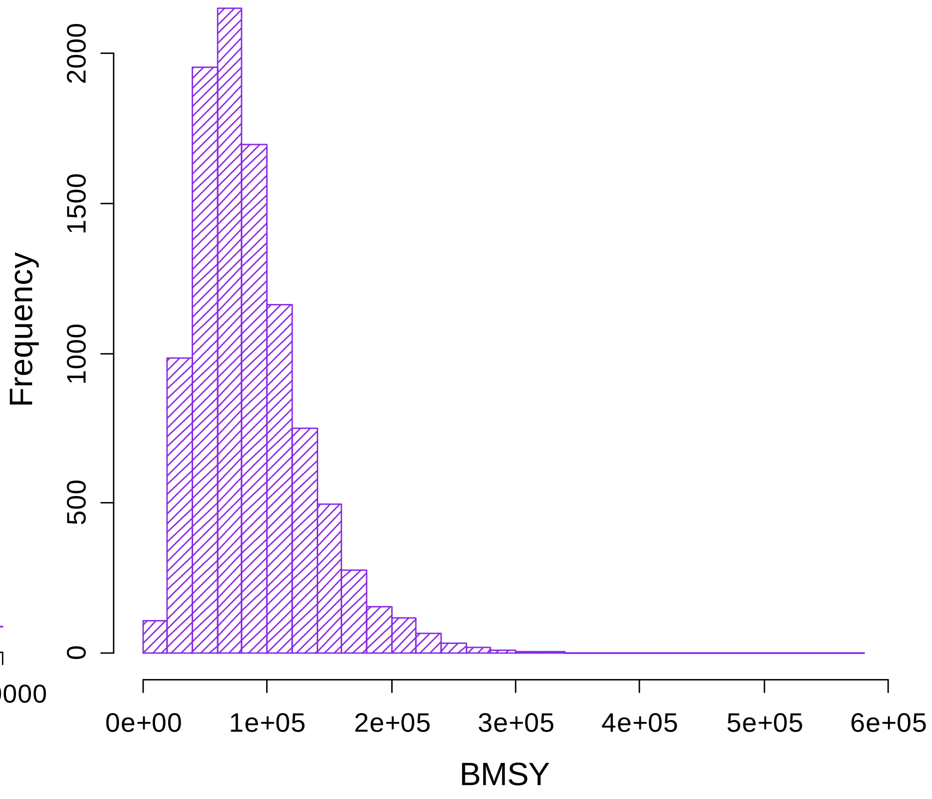


Distributions of B_{MSY}

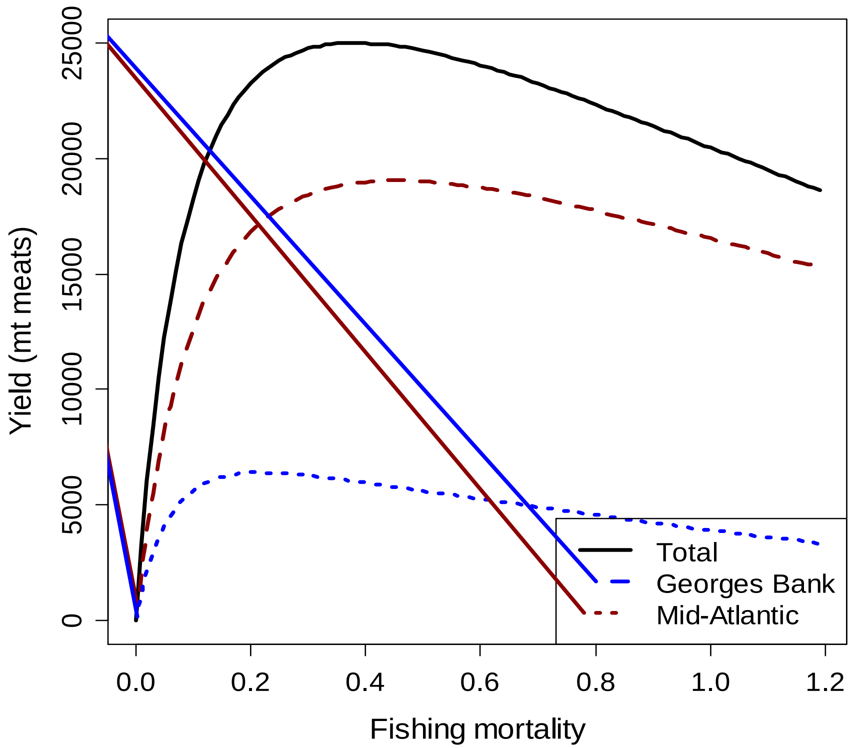
Georges Bank



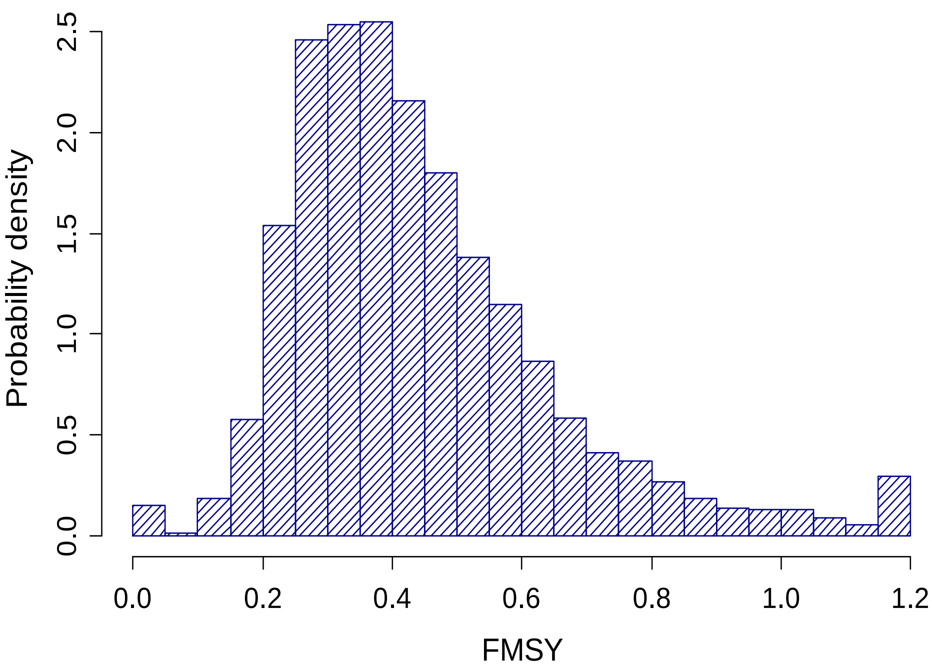
Mid-Atlantic



Median Yield Curves



Distribution of whole-stock FMSY



TOR 5. *Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 4).*

Overfished (biomass) status determination:

Estimated biomass in 2009 from CASA: 129,703 mt (July 1)
Estimated B_{MSY} from SYM: 125,358 mt
Biomass (overfished) threshold: ½ B_{MSY} = 62,679 mt

Thus, sea scallop biomass was above its biomass target in 2009, and over twice the threshold biomass.
Therefore, sea scallops were not overfished in 2009

The same conclusion would be reached using previous reference point methods

Fishing mortality (overfishing) status determination:

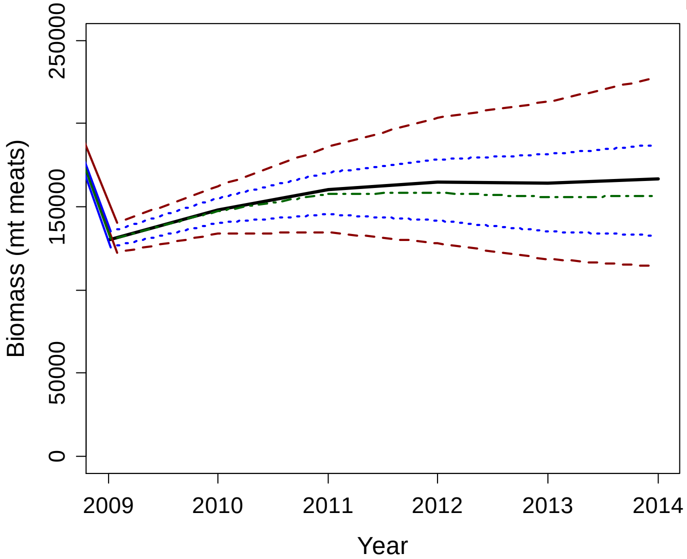
Estimated fishing mortality in 2009 from CASA:	0.38 (0.378)
Estimated F_{MSY} from SYM:	0.38

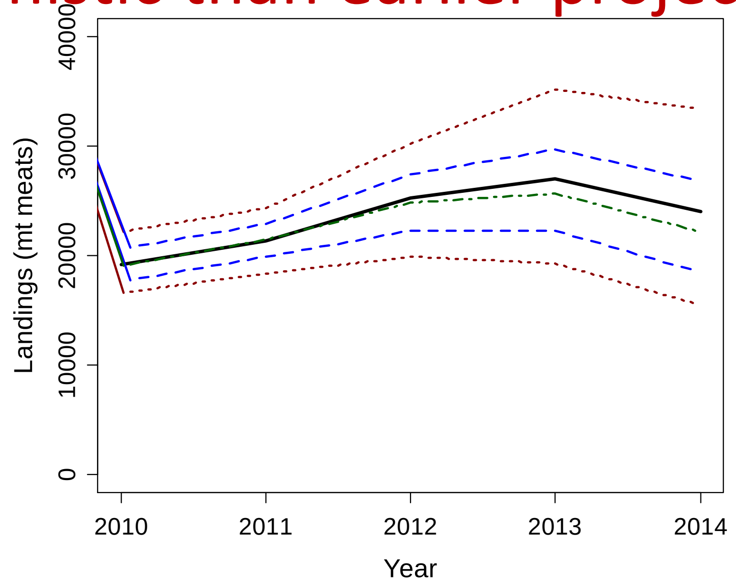
Since fishing mortality in 2009 was not above the estimated F_{MSY} overfishing did not occur in 2009

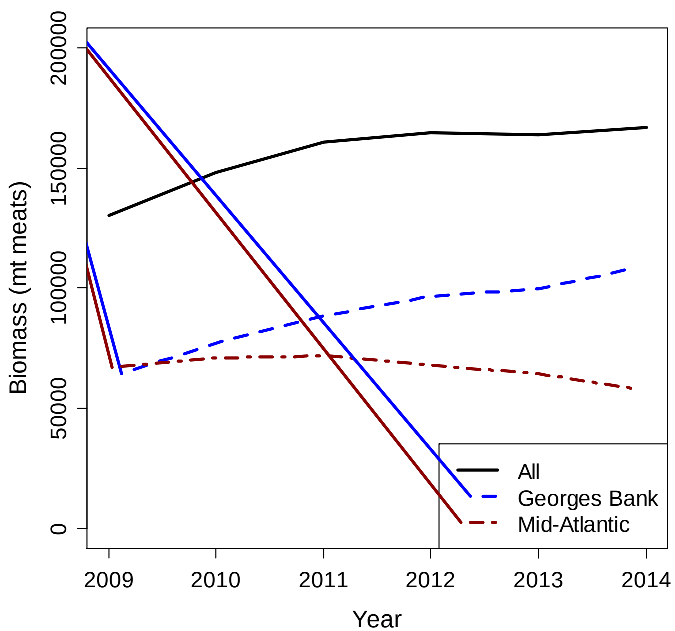
Using the “traffic light” approach, biomass of sea scallops has a green light, whereas fishing mortality has a yellow light

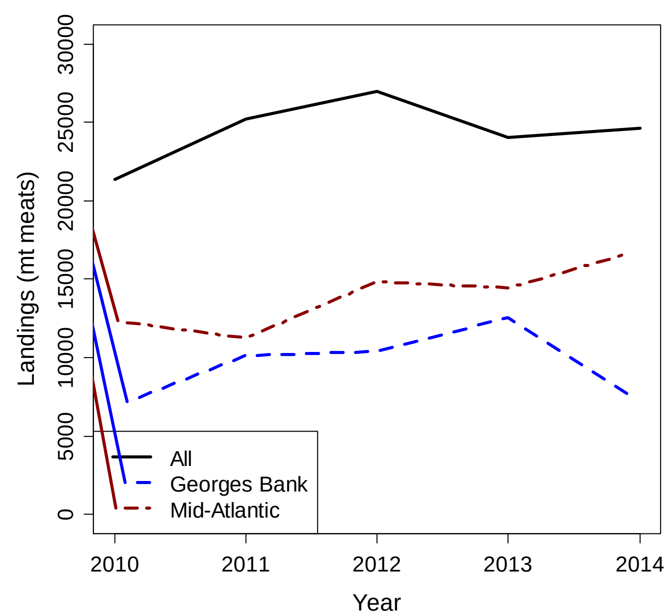
Example projection assuming status-quo management

Note that these are less optimistic than earlier projections









Some cautionary notes

Estimate of MSY assumes that the high recent recruitment in the Mid-Atlantic can be sustained by keeping the biomass high. If the Mid-Atlantic reverts to a more unproductive state, long-term MSY may be much lower

Retrospective pattern in Mid-Atlantic suggests that about 10-20% of the mortality is unaccounted for (incidental, discard, natural mortality all possibilities)

Recruitment in the Mid-Atlantic in 2009 and probably 2010 were poor – potentially a bad sign

Although recruitment on Georges Bank has been strong the last three years, scallop recruitment in this region tends to be cyclical - some years of weak recruitment may be due

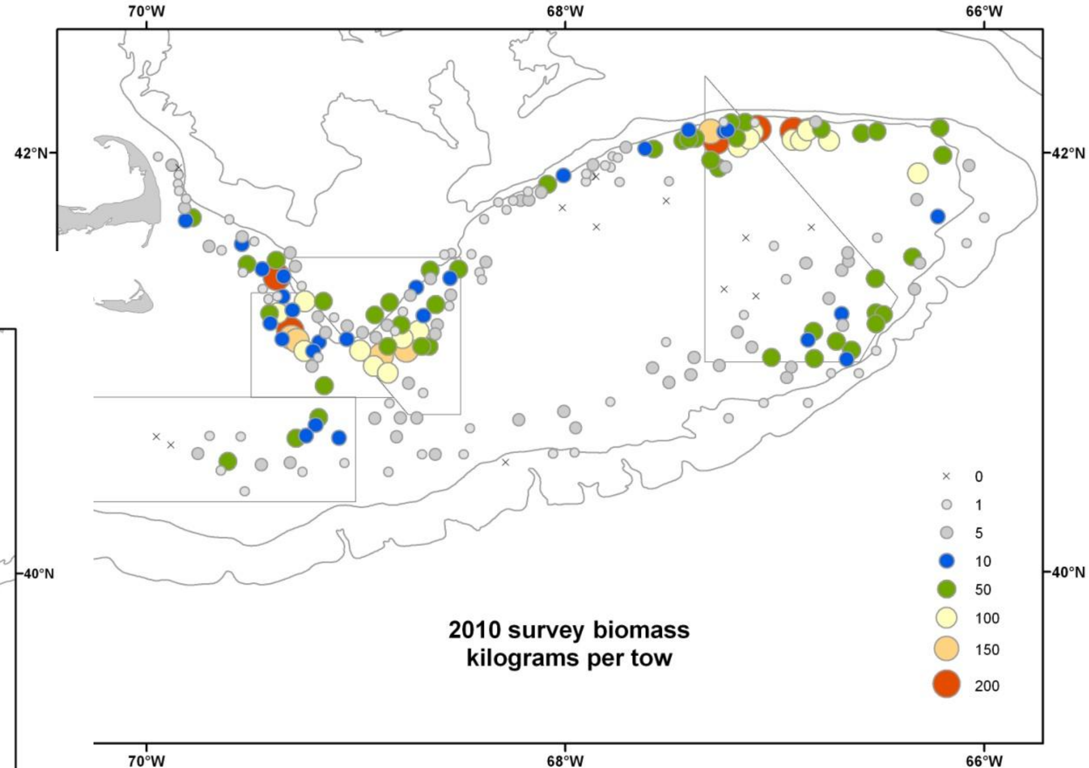
Because 2009 fishing mortality bordered on overfishing, allocations for 2011-2012 will probably need to be less than 2009

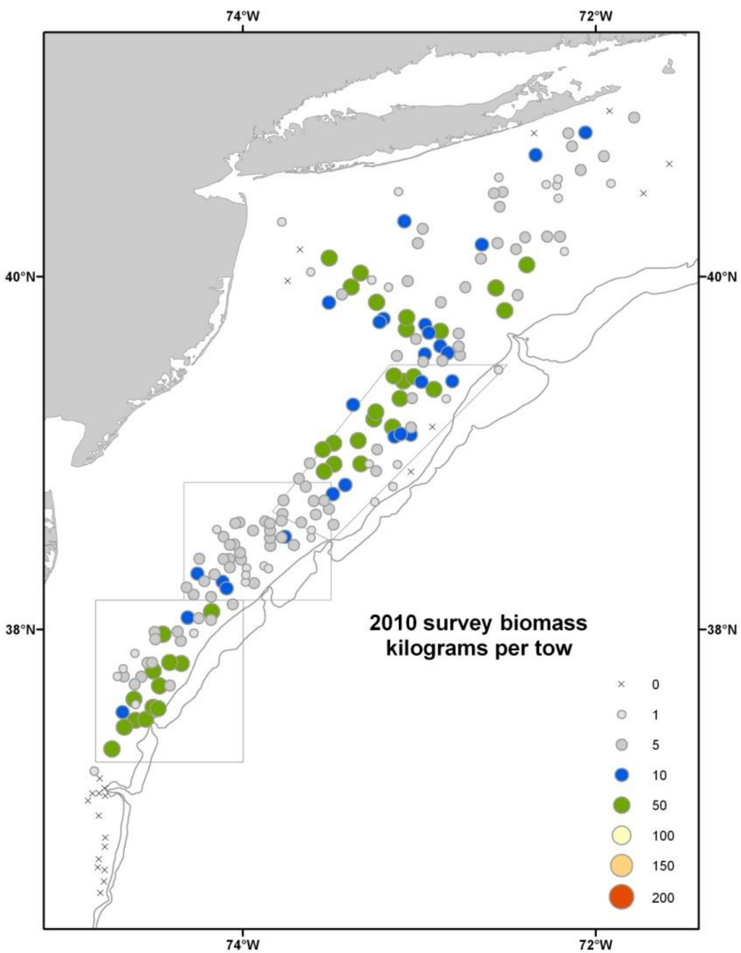
2010 NEFSC sea scallop survey

Conducted on R/V Hugh Sharp for 3rd year

Beside regular survey, several experimental studies were performed (camera tows, duplicate tows, time trials)

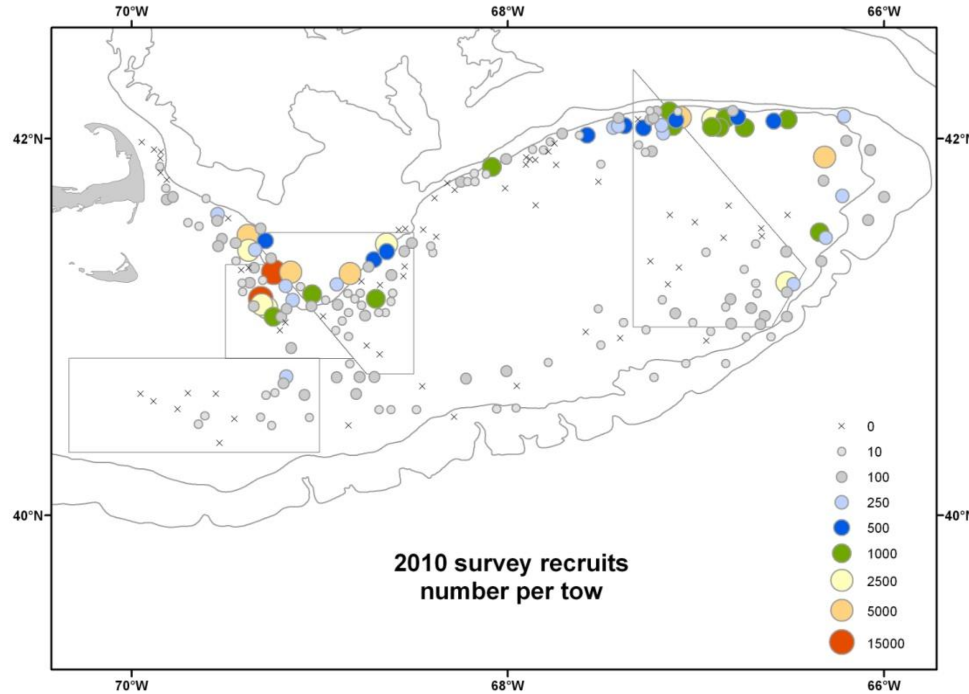
Biomass

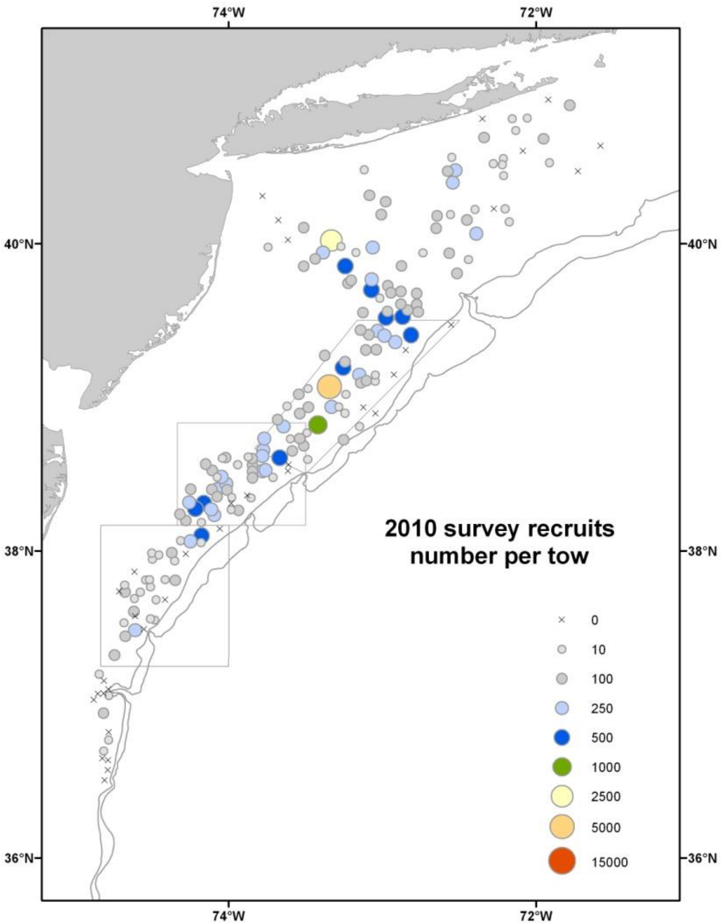




Mid-Atlantic biomass down from 2009, mainly from depletion of Elephant Trunk
Increase on Georges Bank, mainly from growth and continued strong recruitment in the South Channel
Substantial biomass in Closed Area I, especially just south of the “sliver” access area

Recruitment





Continued strong recruitment in South Channel as well as along the northern edge of Georges Bank.

Recruitment in Mid-Atlantic mediocre – mostly concentrated on south rim of Hudson Canyon, with some recruitment in HCCA and Elephant Trunk.

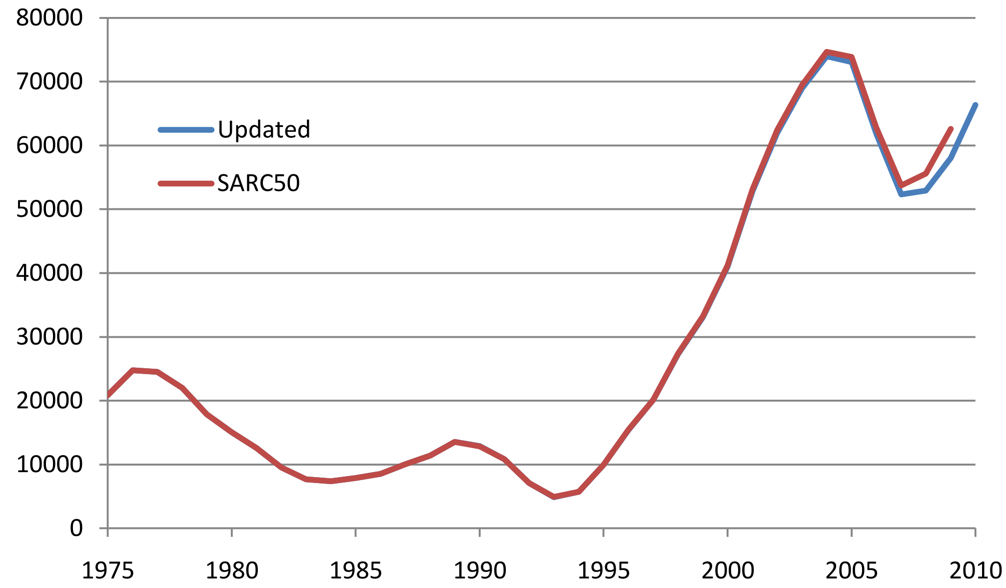
Preliminary 2010 Updated CASA model

Uses 2010 survey data and estimated 2010 landings. Otherwise configured as in SARC-50

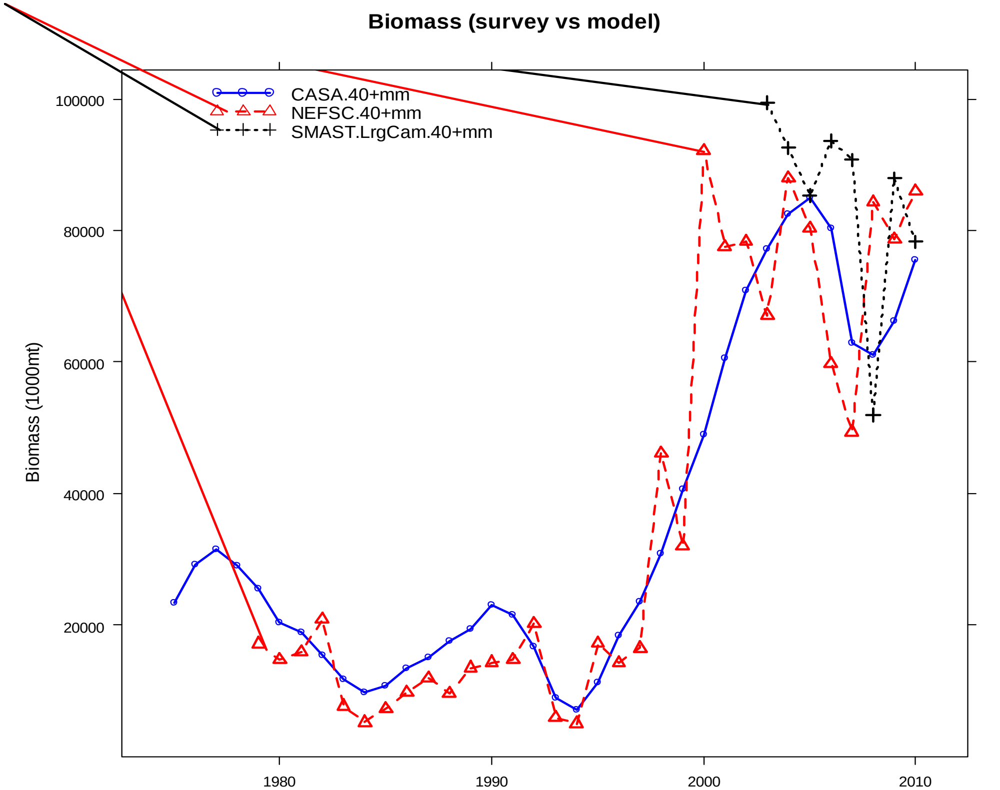
Estimated landings

Year	MA	GB	Total
2009	19350	6695	26045
2010	16000	7500	23500

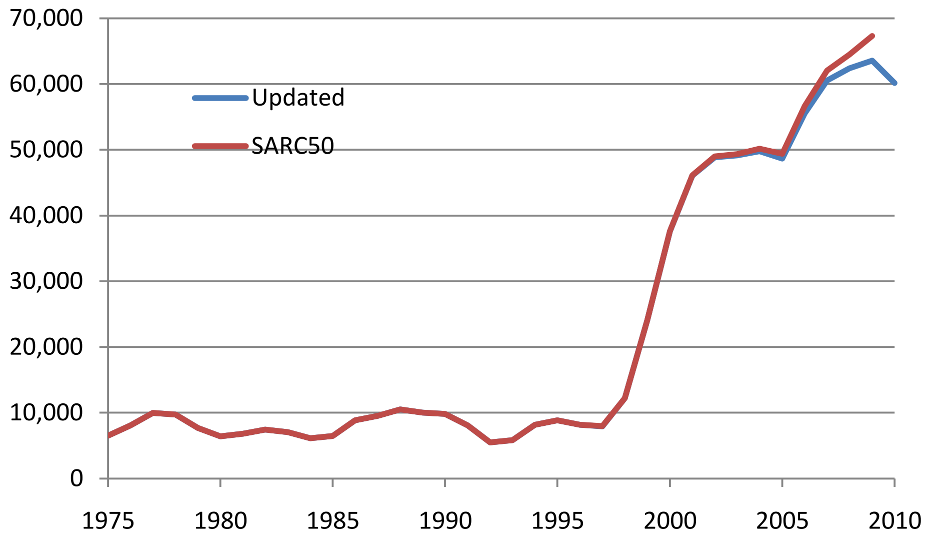
Comparison of estimated biomass between SARC-50 and updated CASA models on Georges Bank



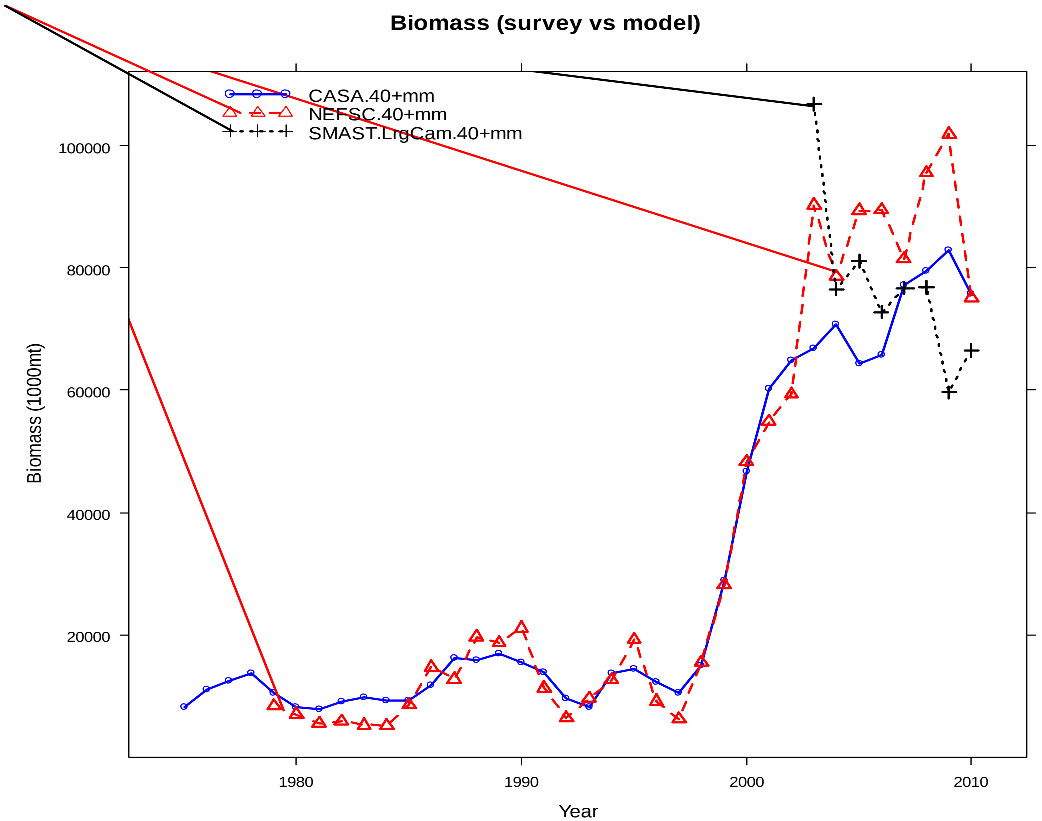
Biomass estimates from surveys and CASA model on Georges Bank



Comparison of estimated biomass between SARC-50 and updated CASA models in the Mid-Atlantic



Biomass estimates from surveys and CASA model in the Mid-Atlantic



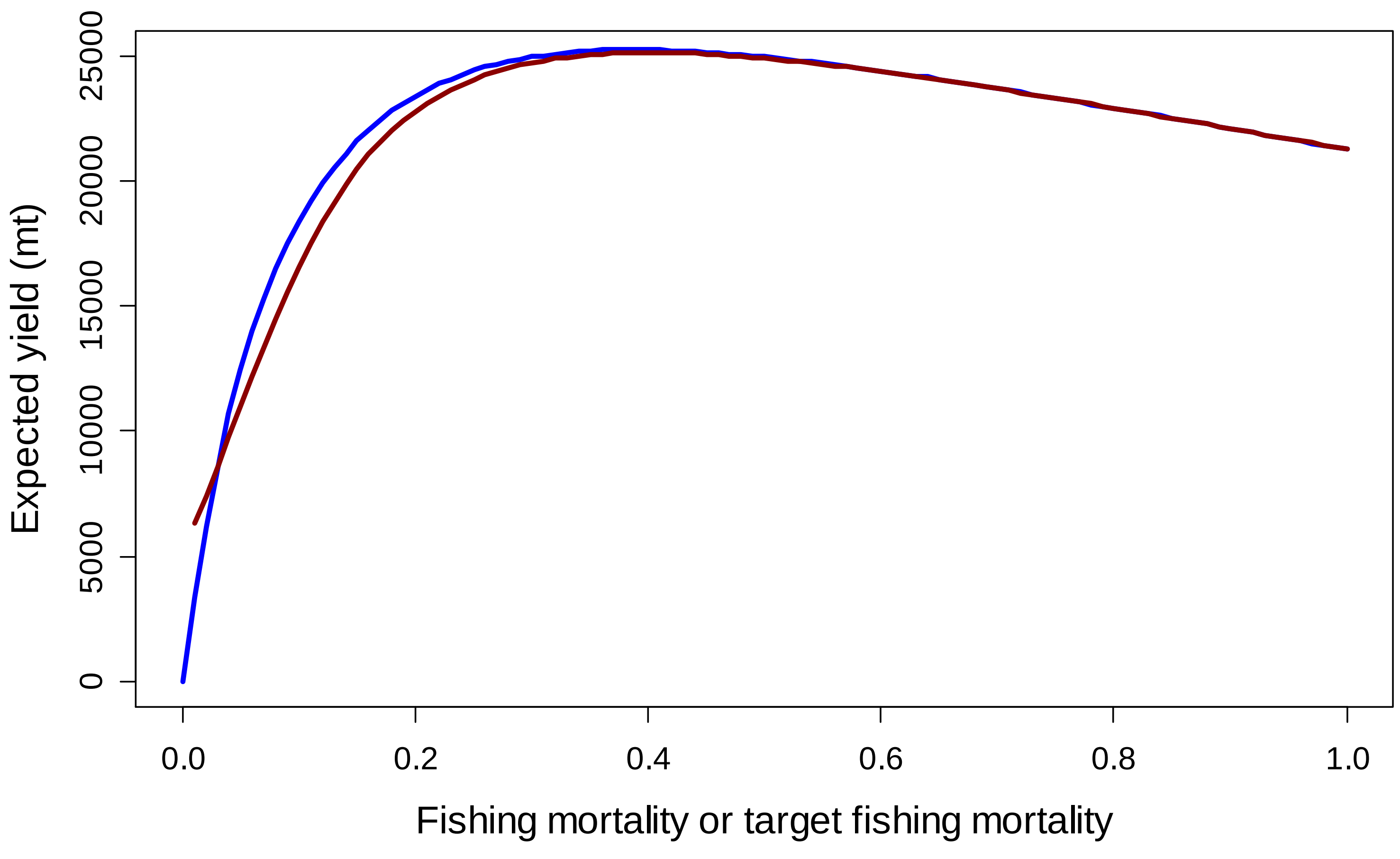
Recommended method of determining ABCs for sea scallops

Sources of uncertainty for overfishing

Uncertainty in reference point - estimated by SYM

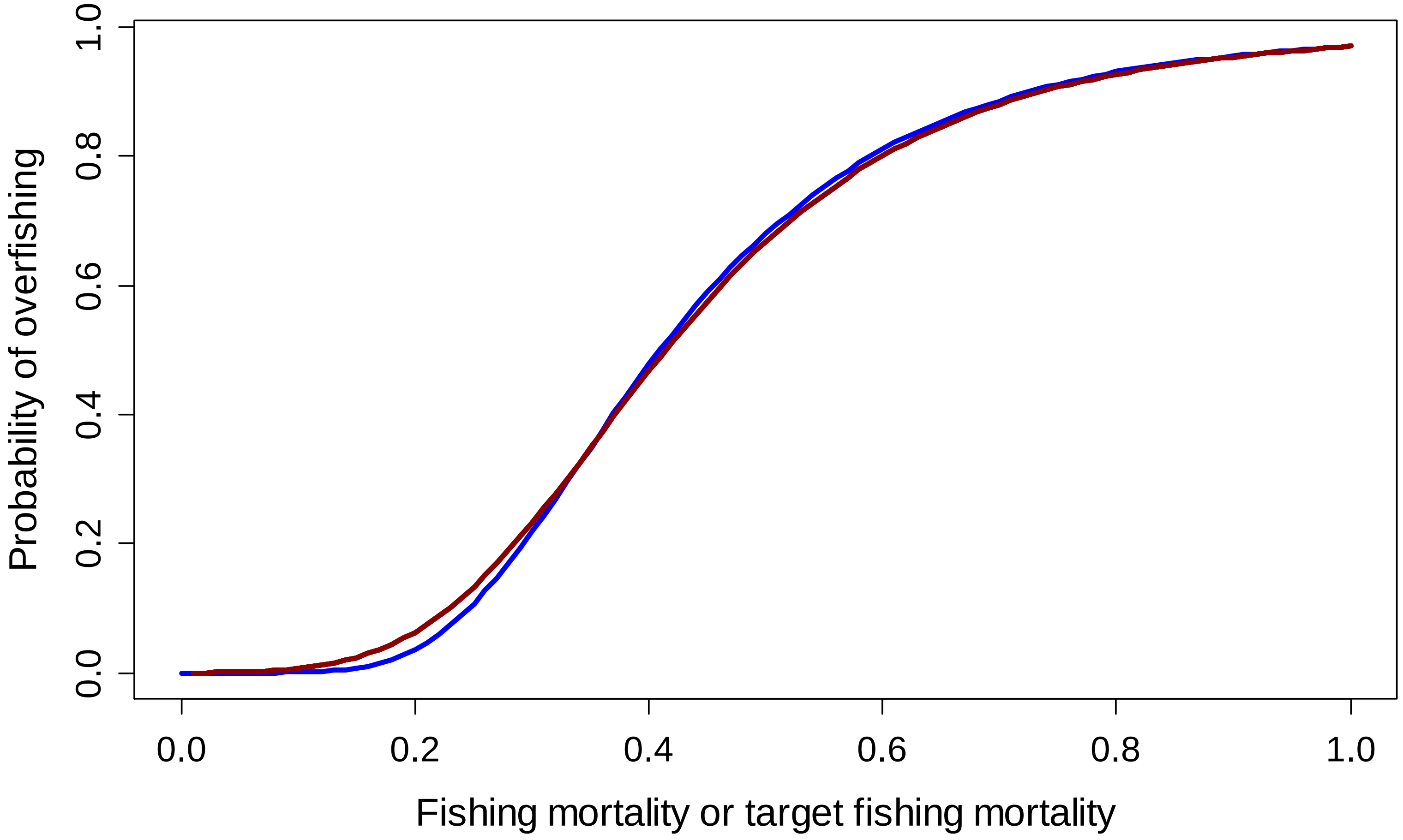
Uncertainty in projected F - assumed to have SE of 0.06 for short term projections

Effects of uncertainty in fishing mortality on expected yield
Lack of precision in F results in loss of yield for low Fs



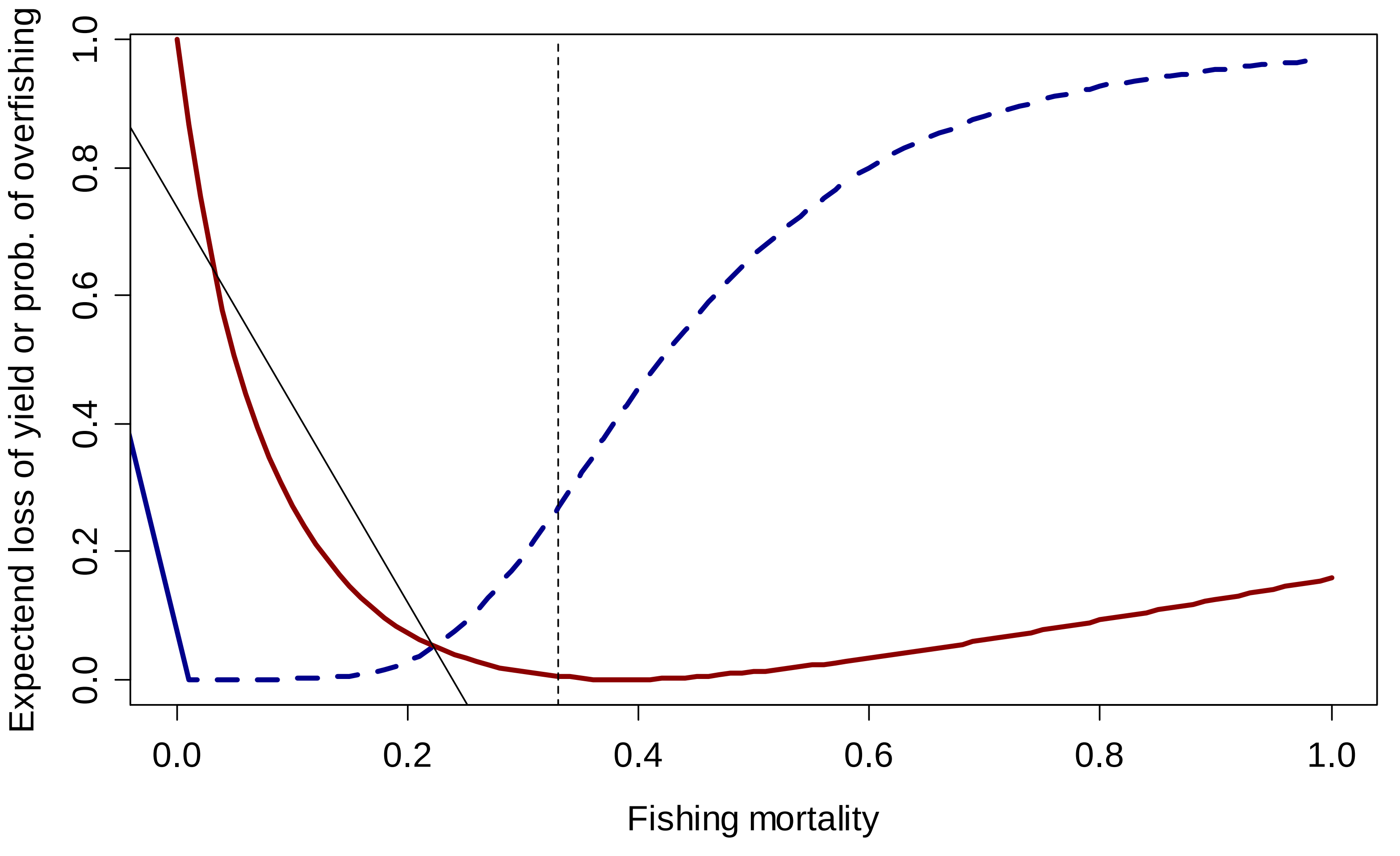
Effects of uncertainty in fishing mortality on overfishing risk

Lack of precision in F increases overfishing risk at low F, decreases it slightly for high F



Probability of overfishing and expected loss of yield assuming no error in fishing mortality

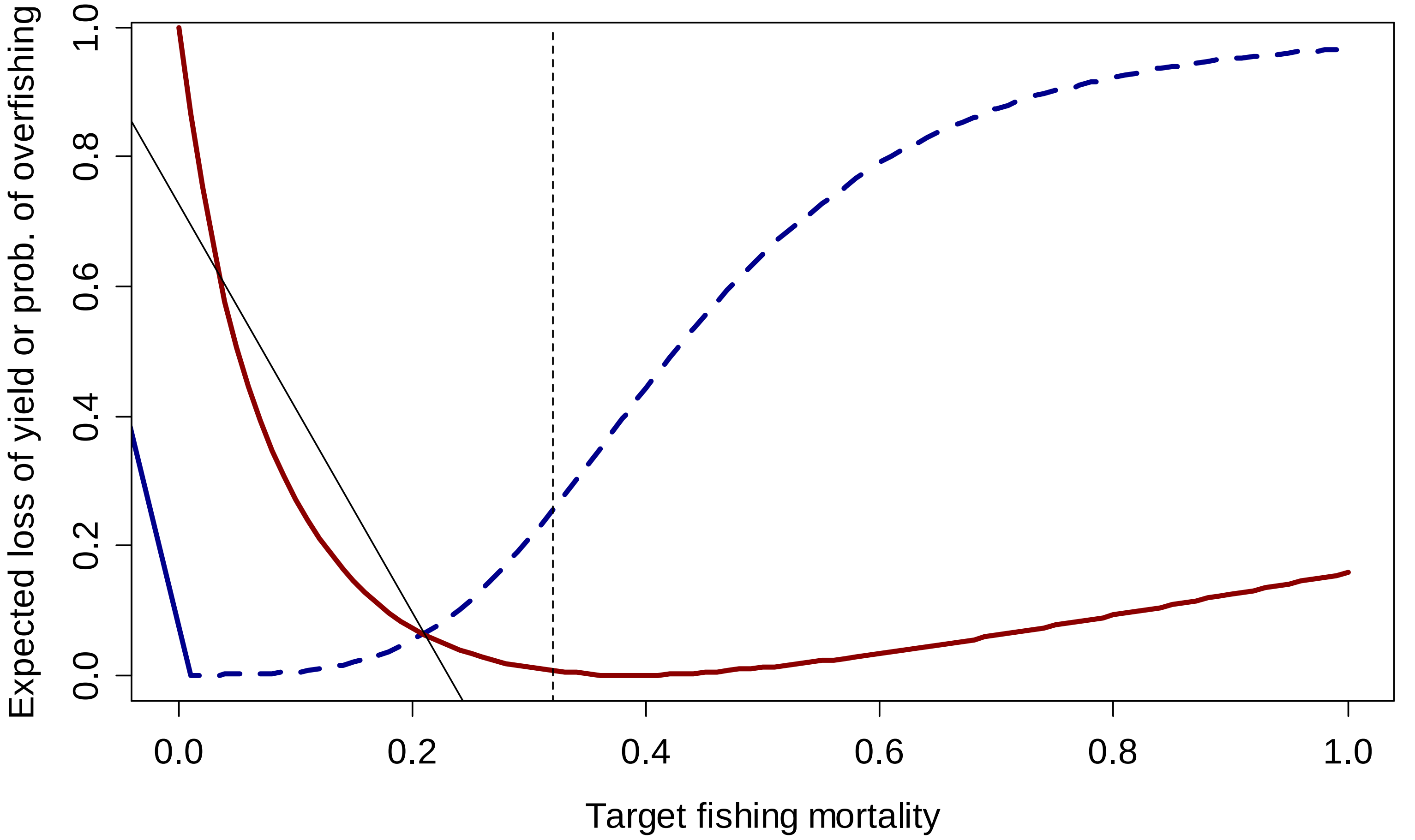
F = 0.33 has about a 0.25 probability of overfishing



Probability of overfishing and expected loss of yield assuming error in fishing mortality

Target F = 0.32 has about a 0.25 probability of overfishing

Probability of 0.15 of realized F being above 0.38



Calculation of ABCs for 2011 and 2012

Initialized with populations at the end of 2010 estimated by the updated CASA model

Population projected forward for two years, assuming an overall F = 0.32 each year

Fishing mortality in the Mid-Atlantic was assumed to be twice that in Georges Bank. Fishing mortality within the regions was assumed spatially uniform

No new recruitment was added – recruitment in 2011 would not recruit to the fishery until 2013

Results

Year	Landings	Discards	Catch	ExplBms
2010				70725
2011	27269	4009	31279	73475
2012	28961	4273	33234	83594

Some caveats

When fishing mortality varies spatially, there is not a 1-1 correspondence between overall fishing mortality and landings – landings at a given F depend on the spatial effort distribution. The effort distribution in turn depends on policy decisions not yet made by the Council. Spatially explicit simulations will be done to inform on these decisions.

Because of these spatial management issues as well as uncertainties in projections, target fishing mortalities and landings should be well below the ABC levels