

NWACS-MICE: Tradeoff Analysis and Ecological Reference Points

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SEDAR 102

ASMFC Atlantic Menhaden and Ecological Reference Points Review Workshop

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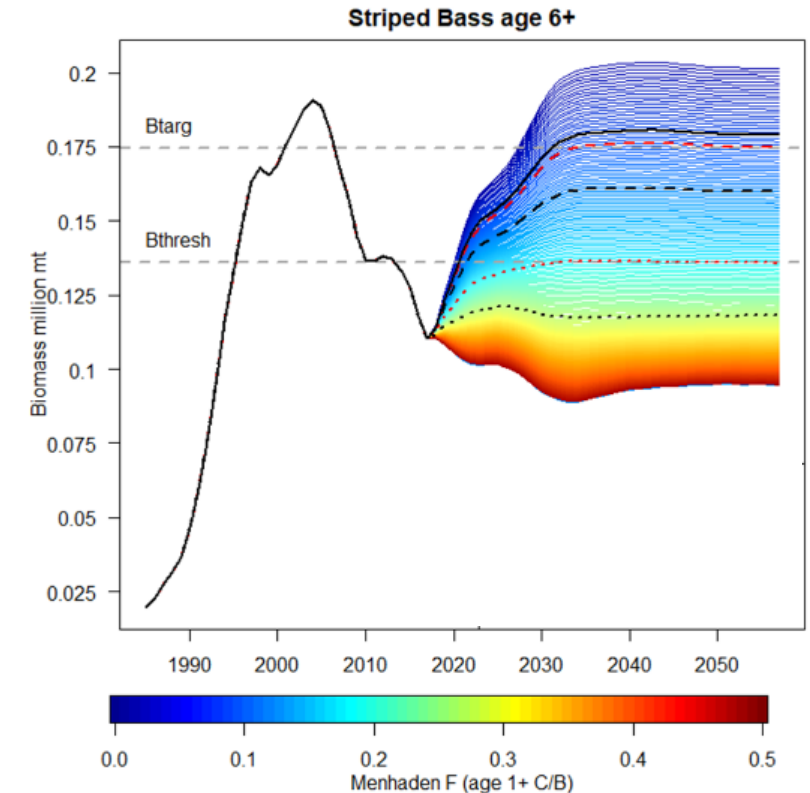
Charleston, SC

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ERP Tradeoff Analysis

Project ecosystem dynamics forward for 40 years (2024-2063) under different combinations of menhaden and striped bass fishing mortality.

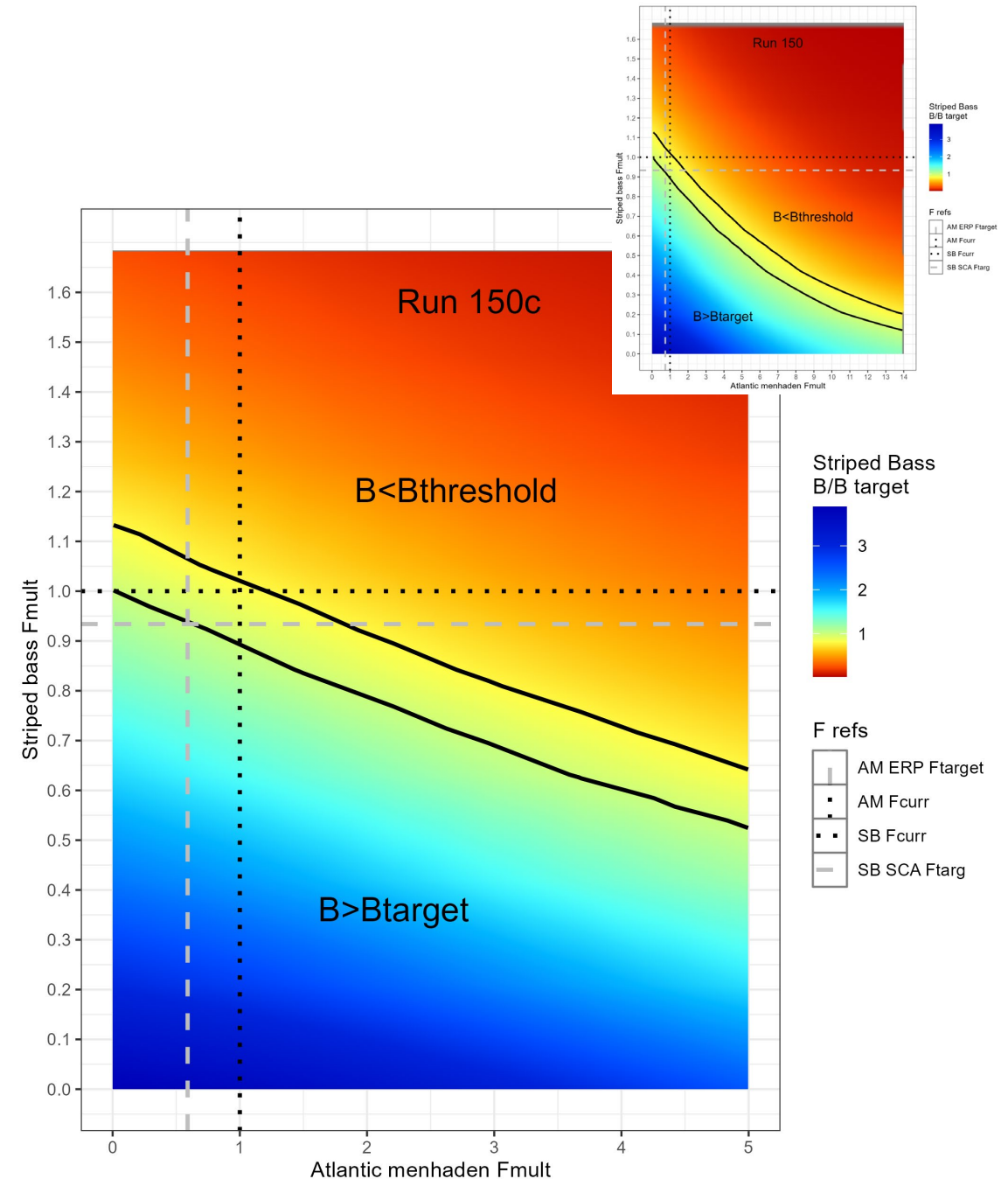
- 400 unique combinations of fishing mortality.
 - 0 to $2 \cdot M$, applied as multipliers on F_{2023}
 - All other species held constant at status quo (2023) F rates
- Current (low) recruitment assumed for Atlantic herring in future projections
- Striped bass age 6+ equilibrium biomass (SSB proxy) ratio calculated as $B_{\text{Year}}/B_{\text{target}}$
 - $B_{\text{target}} = 1.25 \cdot B_{1995}$
 - $B_{\text{threshold}} = B_{1995}$
- Create surface plot of Bratio across menhaden and striped bass F combinations
- Identify ERP target and thresholds.



NWACS-MICE ERP Tradeoff Analysis

At current striped bass and menhaden F rates, striped bass fall above the threshold but below the target.

At striped bass F target ($F_{mult} = 0.934$), they reach their biomass target across a range of menhaden F.

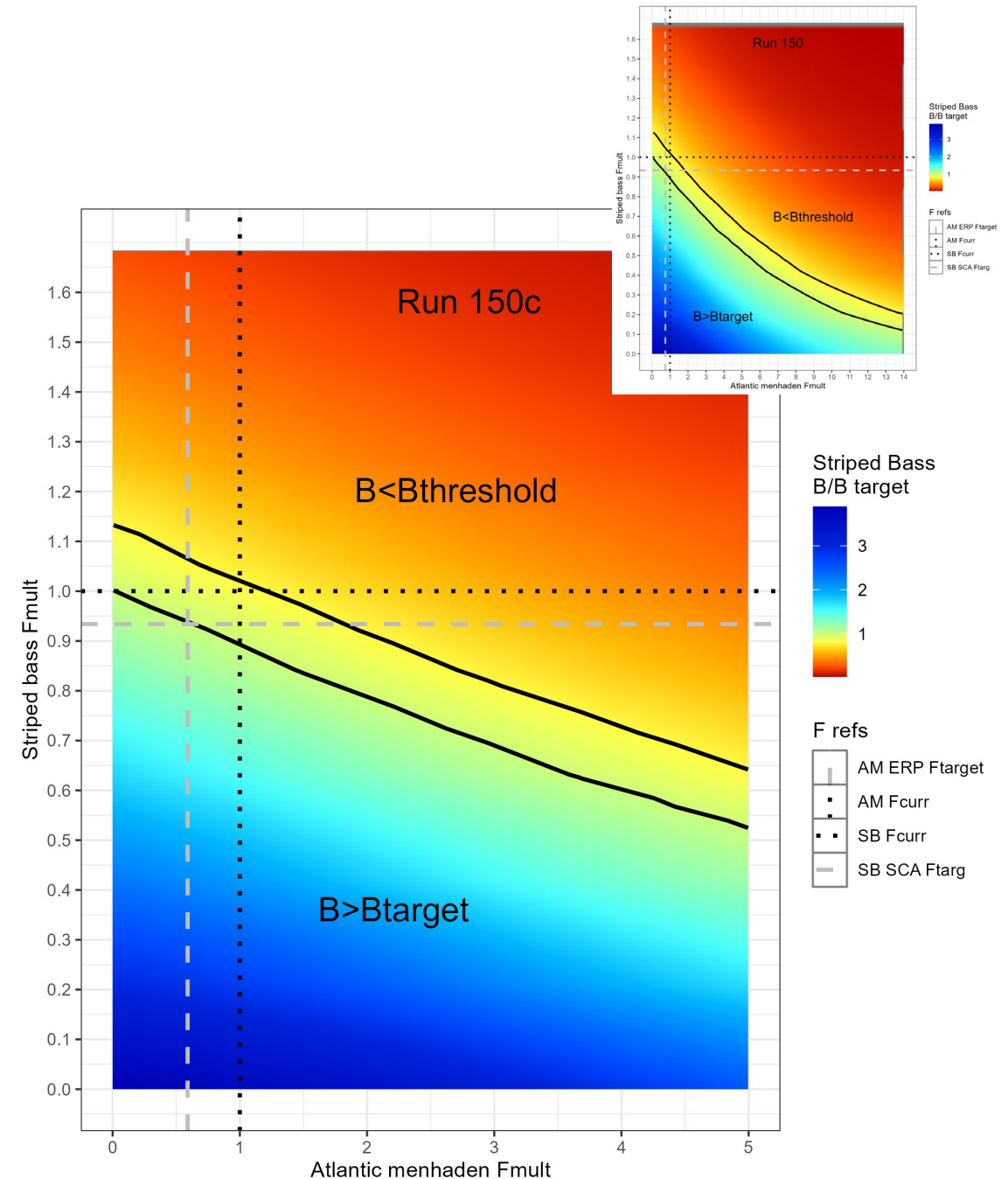


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ERP Tradeoff Analysis

ERP F_{target} : The menhaden F rate where striped bass $B_{\text{ratio}}=1$, when striped bass are fished at F target.

ERP $F_{\text{threshold}}$: The menhaden F rate where striped bass $B_{\text{ratio}}=0.8$, when striped bass are fished at F target.



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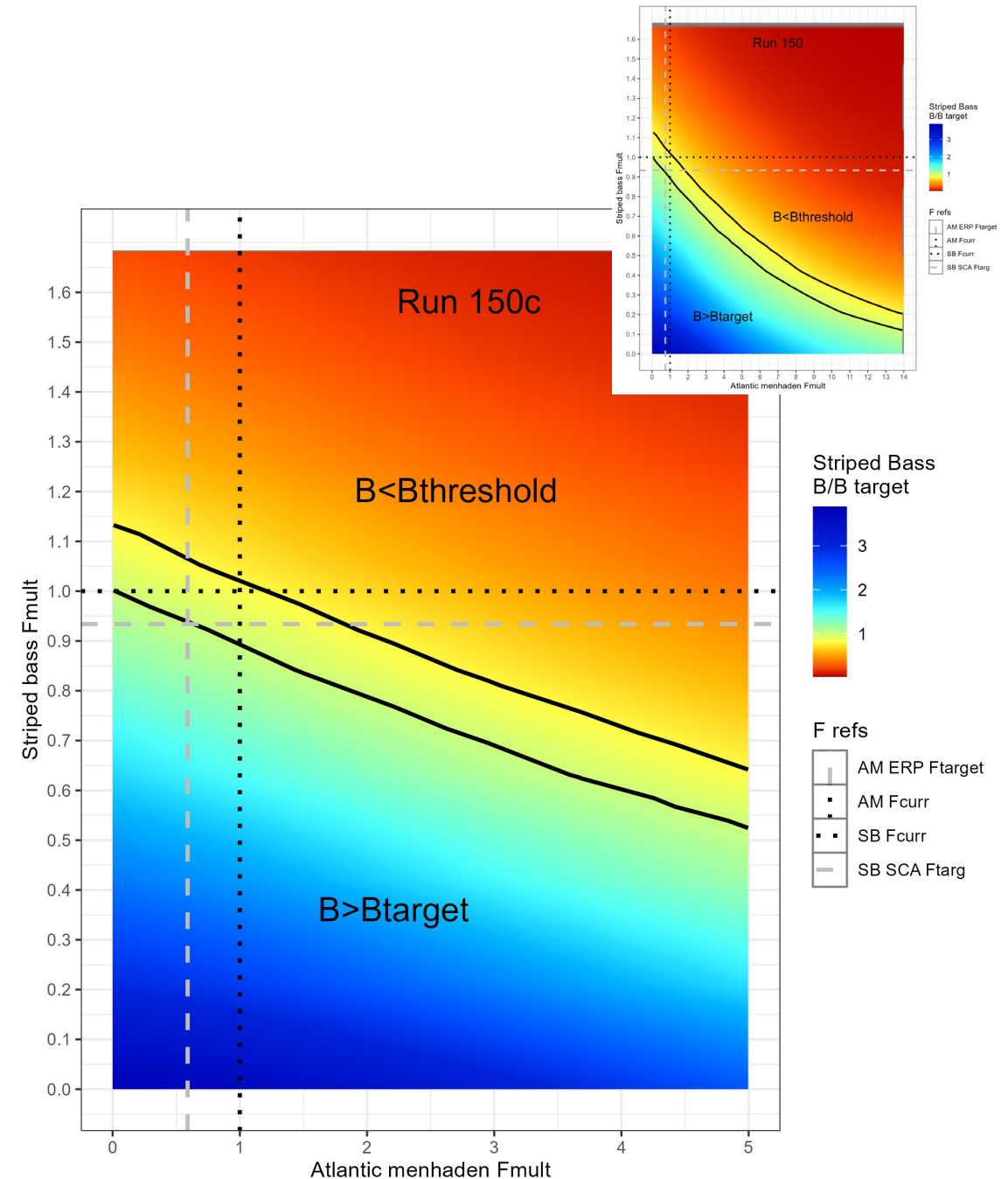
ERP Tradeoff Analysis

ERPs are identified through interpolation of Bratio over values of striped bass and menhaden F and lookup.

Coarse interpolation (10 steps per F rate) reduced the precision on the estimates and created upward bias in the ERPs.

Interpolation was increased by an order of magnitude (see report addendum).

Ref Point	run 150 0.1 interpolation	run 150 0.01 interpolation
ERP Fmult target	0.737	0.589
ERP Fmult threshold	1.916	1.791
Current F BAM	0.256	0.256
ERP Ftarget BAM	0.189	0.151
ERP Fthreshold BAM	0.490	0.458

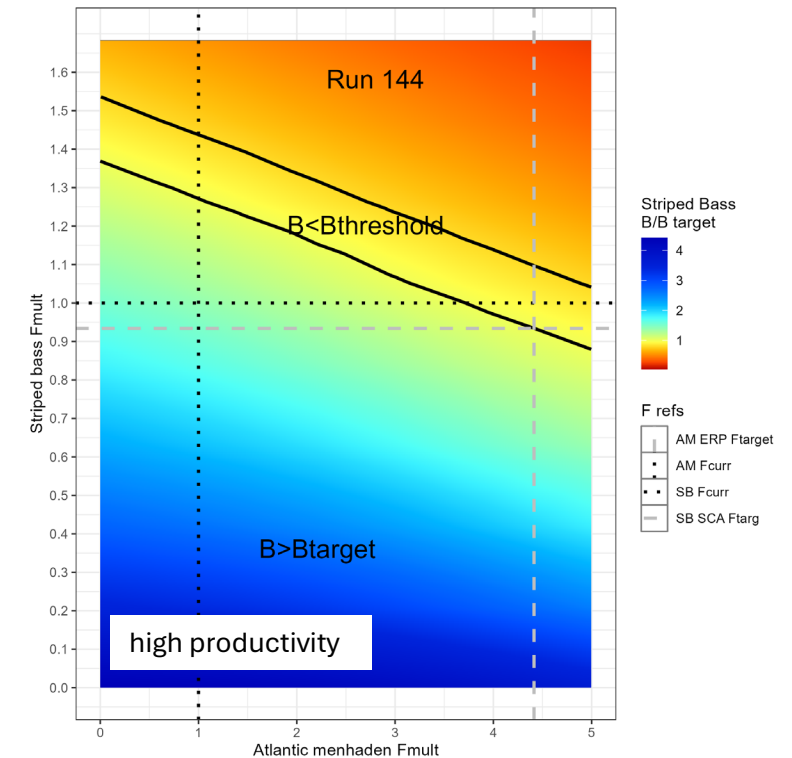
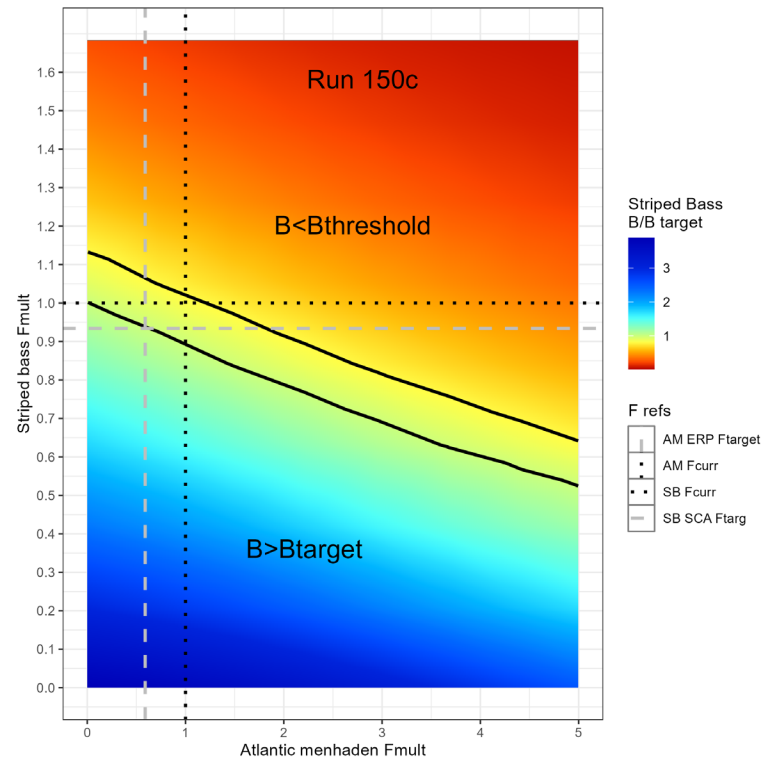
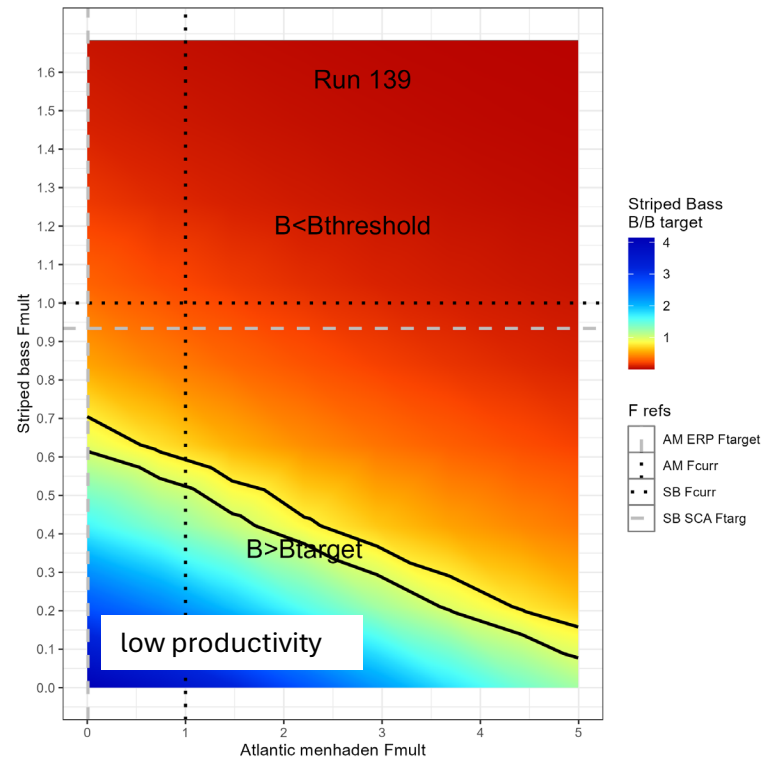


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ERP Tradeoff Analysis

ERPs depend on striped bass productivity regime represented by the different models.

Ref Point	run 139	run 144	run 150
ERP Fmult target	0.007	4.414	0.589
ERP Fmult threshold	0.007	6.226	1.791
Current F BAM	0.256	0.256	0.256
ERP Ftarget BAM	0.002	1.129	0.151
ERP Fthreshold BAM	0.002	1.593	0.458



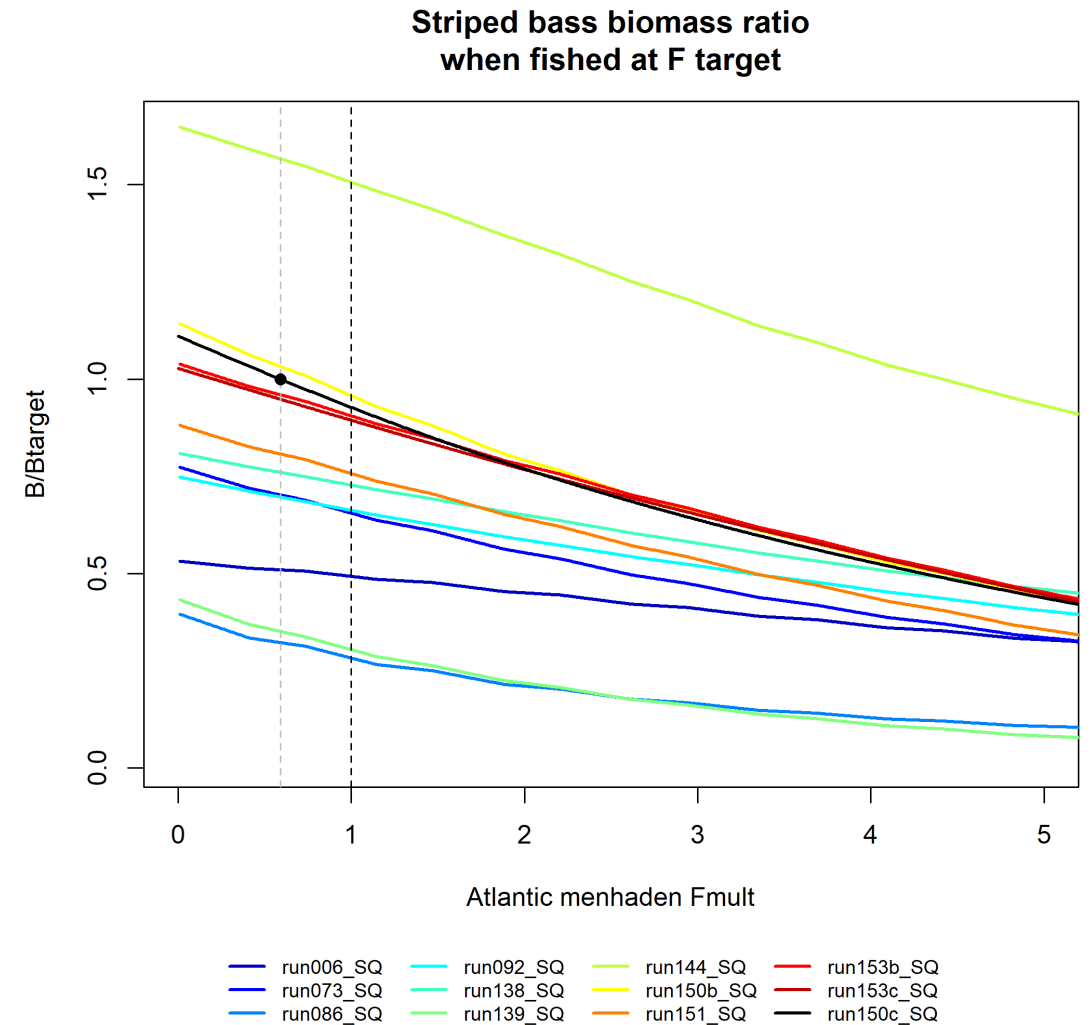
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ERP Tradeoff Analysis

ERPs depend on striped bass productivity regime represented by the different models.

The slope of the tradeoff relationship is consistent across the range of menhaden F rates likely to be experienced.

But, the position along the y-axis



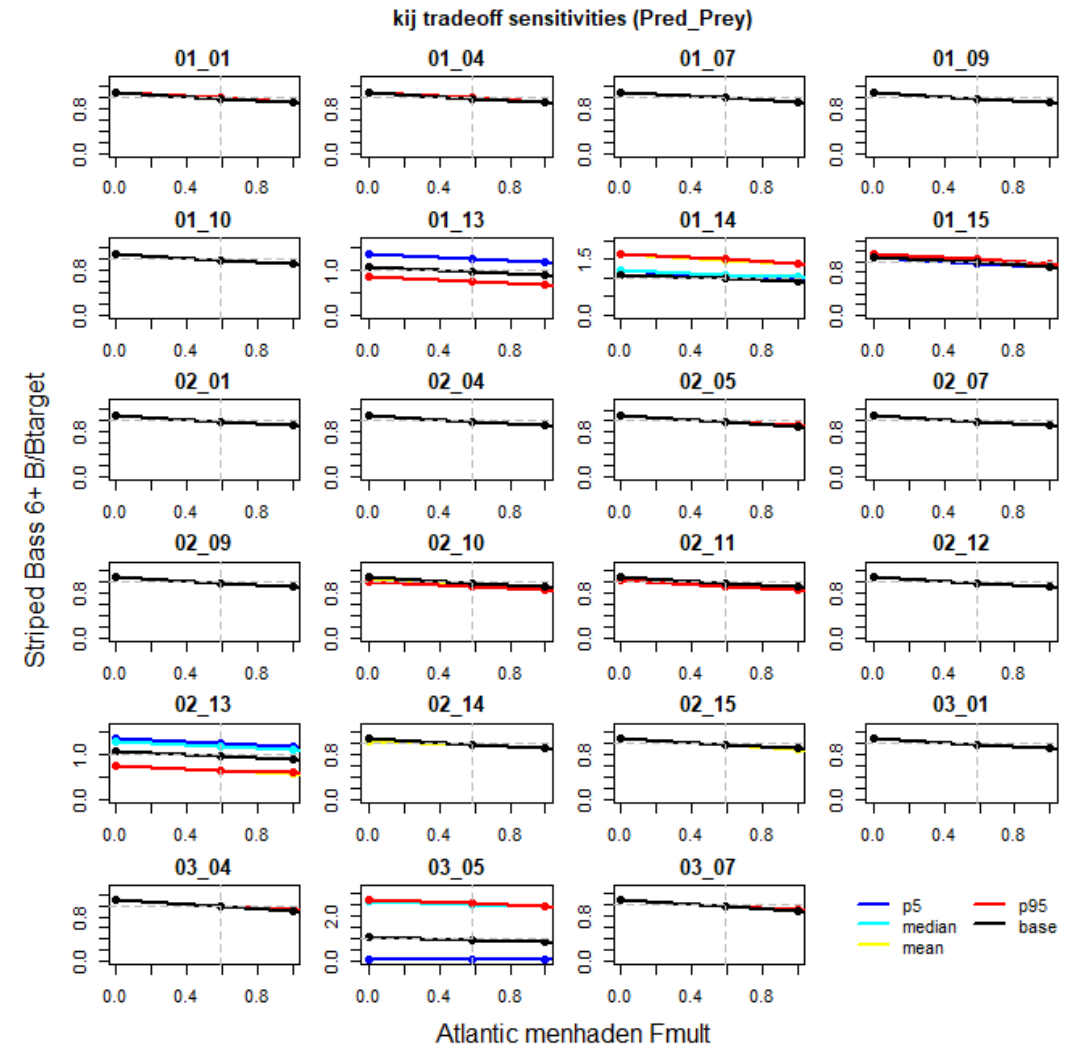
NWACS-MICE ERP Sensitivities

Uncertainty in ERPs were evaluated based on estimated k_{ij} (off bounds) from 153 runs.

- Summary statistics, percentiles
- Fitted to probability distribution models (normal, lognormal, gamma)

Projections were run under alternative k_{ij} 's.

- striped bass at F_{target} ($F_{\text{mult}}=0.934$) and Atlantic menhaden fished at $F=0$, $F=F_{\text{target}}$, $F=1$, and $F=M$.



See report addendum

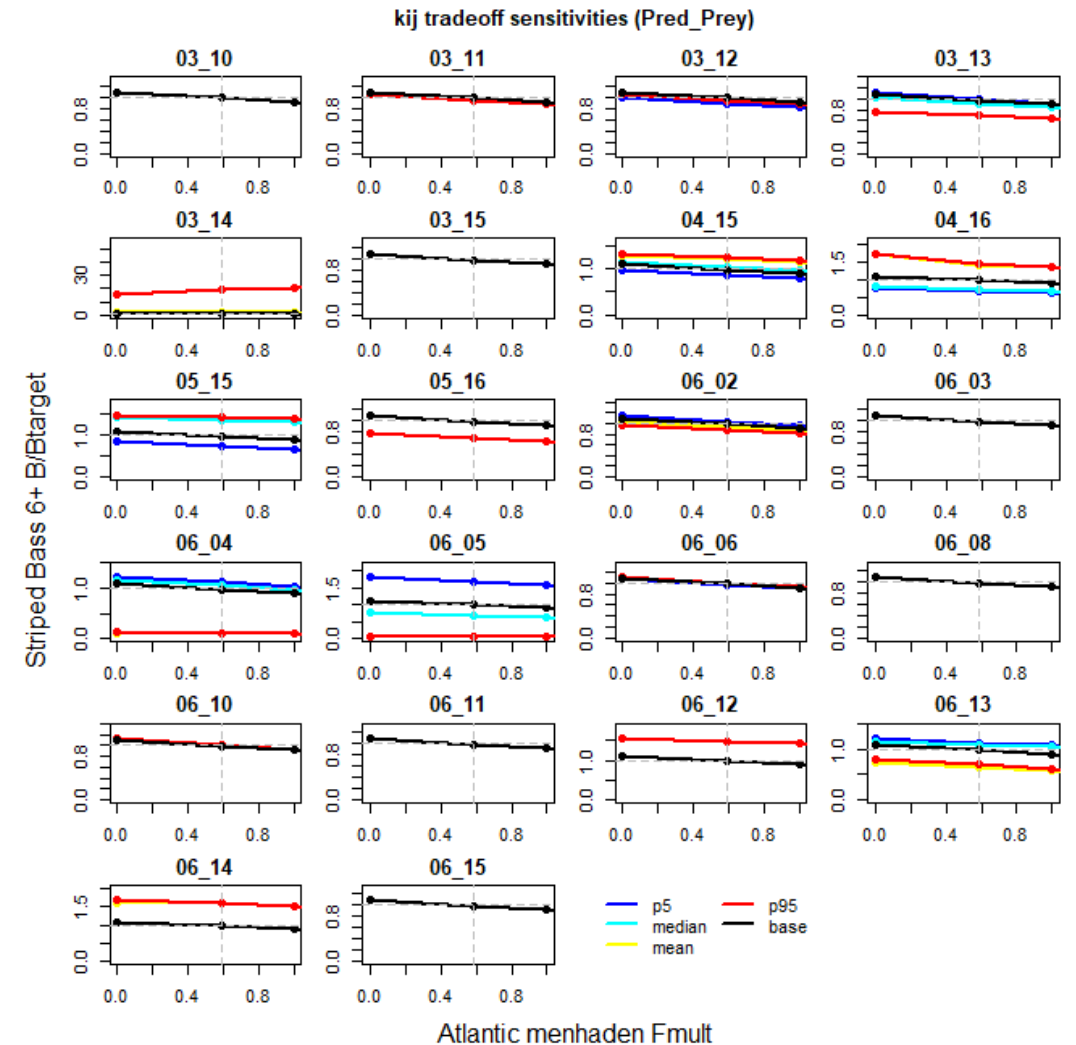
NWACS-MICE ERP Sensitivities

Uncertainty in ERPs were evaluated based on estimated k_{ij} (off bounds) from 153 runs.

- Summary statistics, percentiles
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Projections were run under alternative k_{ij} 's.

- striped bass at F_{target} ($F_{\text{mult}}=0.934$) and Atlantic menhaden fished at $F=0$, $F=F_{\text{ERP } F_{\text{target}}}$, $F=1$, and $F=M$.



See report addendum

NWACS-MICE ERP Sensitivities

Sensitivity in ERPs were evaluated based on uncertainty around estimated k_{ij} (off bounds) from 153 runs.

- Summary statistics, percentiles
- Fitted to probability distribution models (normal, lognormal, gamma)

Projections were run under alternative k_{ij} 's.

- striped bass at F_{target} ($F_{mult}=0.934$) and Atlantic menhaden fished at $F=0$, $F=ERP\ F_{target}$, $F=1$, and $F=M$.

Sensitive k_{ij} identified from range of $Bratios$ at $ERP\ F_{target}$.

kij label	pred num	prey num	pred	prey	B ratio range
03_14	3	14	striped bass 6+	benthic inverts	18.187
03_05	3	5	striped bass 6+	menhaden adult	2.471
06_05	6	5	spiny dogfish	menhaden adult	1.632
06_04	6	4	spiny dogfish	menhaden juv	1.013
04_16	4	16	menhaden juv	phytoplankton	0.737
05_15	5	15	menhaden adult	zooplankton	0.690
06_14	6	14	spiny dogfish	benthic inverts	0.613
02_13	2	13	striped bass 2-5	anchovies	0.593
01_14	1	14	stiped bass 0	benthic inverts	0.516
01_13	1	13	stiped bass 0	anchovies	0.516
06_12	6	12	spiny dogfish	Atlantic herring 2+	0.499
06_13	6	13	spiny dogfish	anchovies	0.483
04_15	4	15	menhaden juv	zooplankton	0.374
03_13	3	13	striped bass 6+	anchovies	0.311
05_16	5	16	menhaden adult	phytoplankton	0.297
06_02	6	2	spiny dogfish	striped bass 2-5	0.154
03_12	3	12	striped bass 6+	Atlantic herring 2+	0.095

See report addendum