



Review & Synthesis of Results

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SEDAR 102

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Ecosystem Model Development and Integration

- The ERP WG advanced ecosystem modeling by updating NWACS-MICE (preferred), NWACS-FULL, and VADER from the 2020 benchmark.
- A major change was the revised M in the BAM single-species model, integrated across all ERP models.
- This propagation of M improved alignment and ecological coherence in predator-prey modeling.
- VADER's attempted bottom-up feedback did not work out, but validated the value of recruitment-forcing approaches.
- This suite of models supports ERP development and ecosystem-based management across multiple predator-prey linkages.

Biomass and Exploitation Trends

- EwE models tracked biomass of menhaden and striped bass similarly to SS, but with less year-to-year variability due to differing recruitment dynamics.
- NWACS-FULL better matched SS for striped bass ages 2–5; NWACS-MICE better tracked age 6+.
- Differences reflected Ecopath assumptions about biomass accumulation and initial balancing.
- Exploitation rates (F) were consistent across EwE models, as BAM-derived F was used as direct input.

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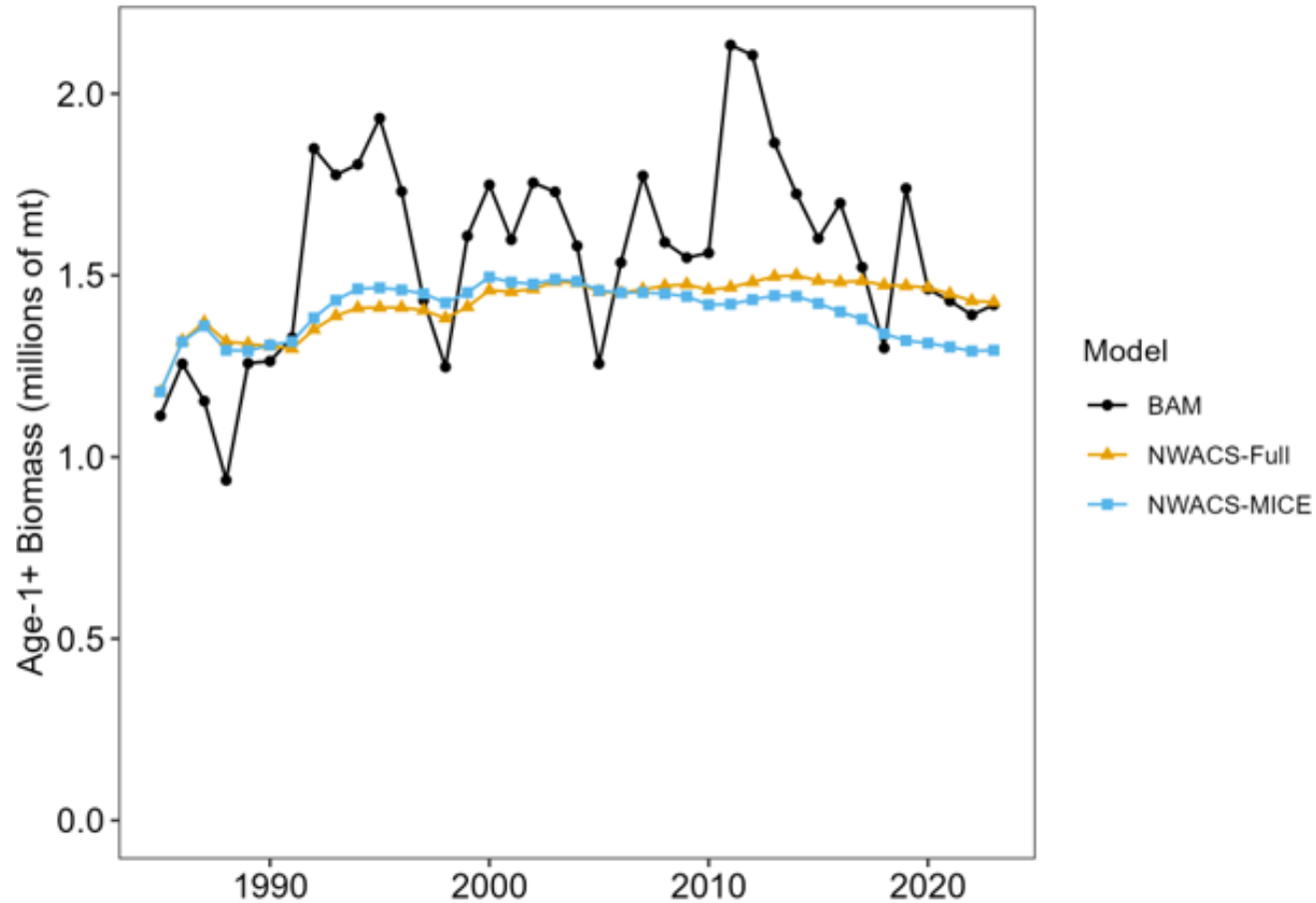


Figure 70. Age-1+ biomass of Atlantic menhaden from the single-species assessment (BAM) and the NWACS ecosystem models, 1985-2023.

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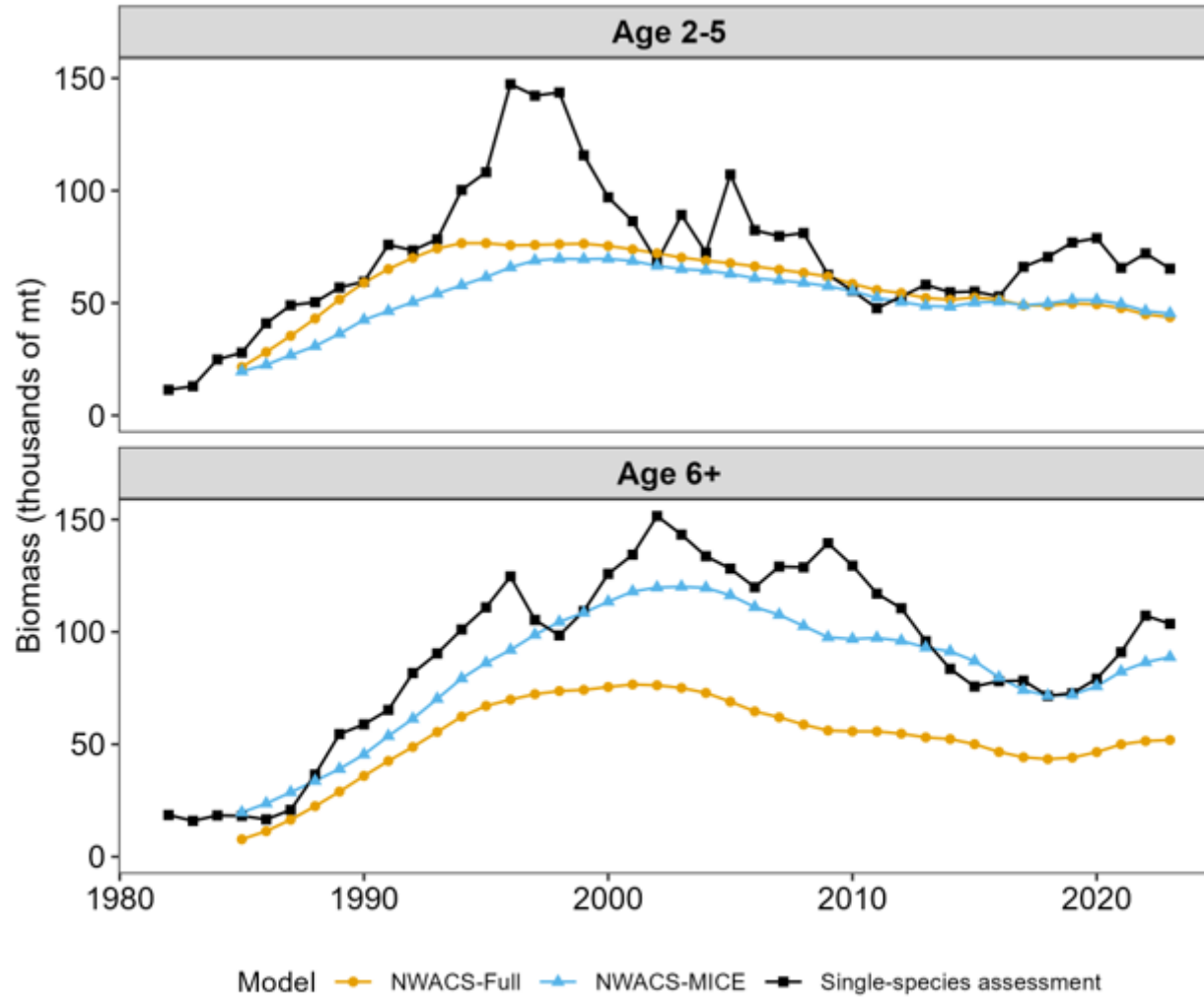


Figure 71. Comparison of striped bass biomass estimates for the non-recruit stanzas for the single-species assessment and the NWACS ecosystem models.

Predation Mortality and Diet Composition

- NWACS-FULL estimated higher predation mortality (M2) for both age-0 and age-1+ menhaden than MICE.
- Both models showed rising M2 over time, particularly for age-0 menhaden.
- Differences in predator diets were notable: FULL showed a concave diet trend in medium striped bass, while MICE showed a convex one.
- FULL predicted more menhaden in large striped bass, bluefish, and spiny dogfish diets.
- These differences stemmed from model design, vulnerability parameter estimation, and prey switching.

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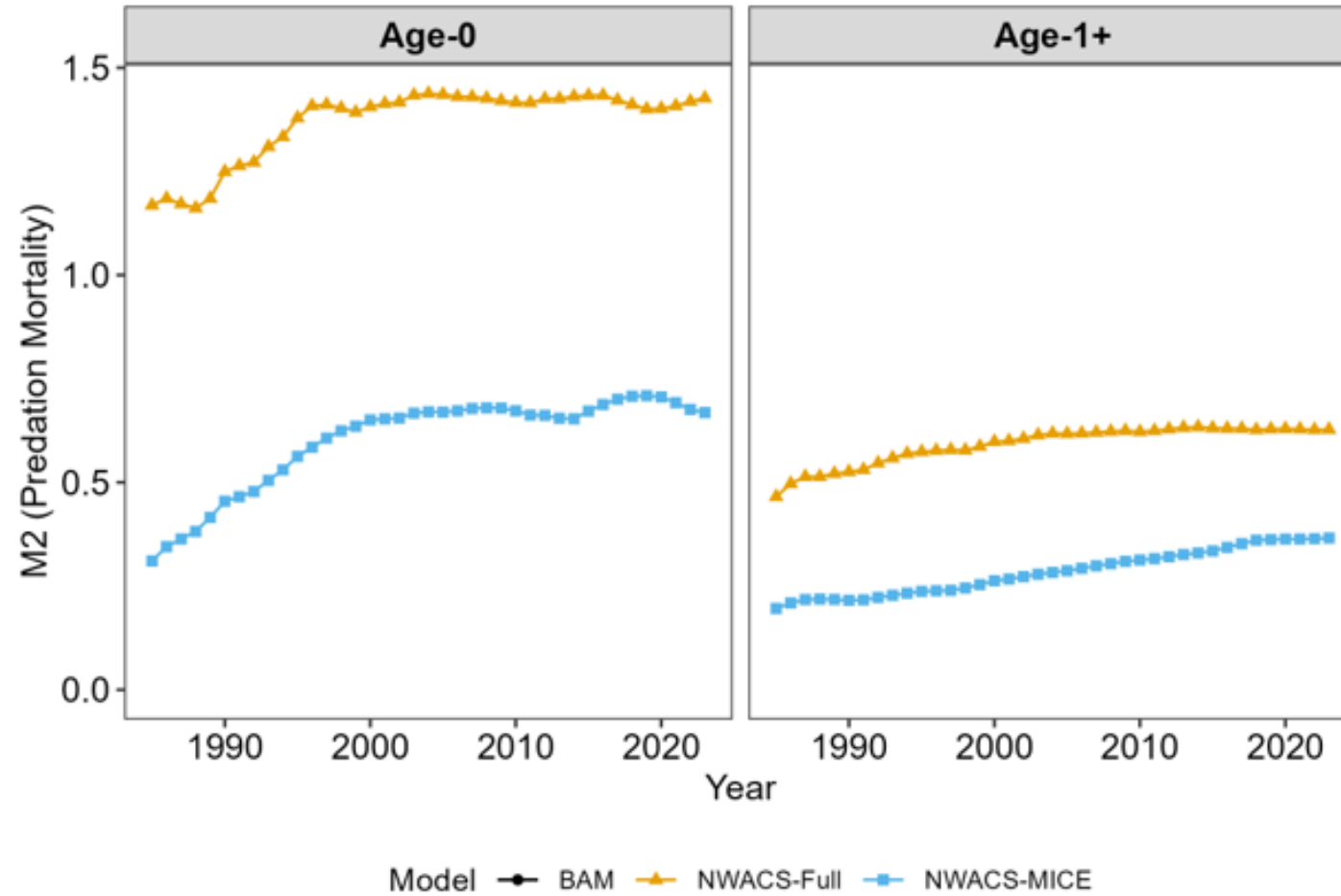
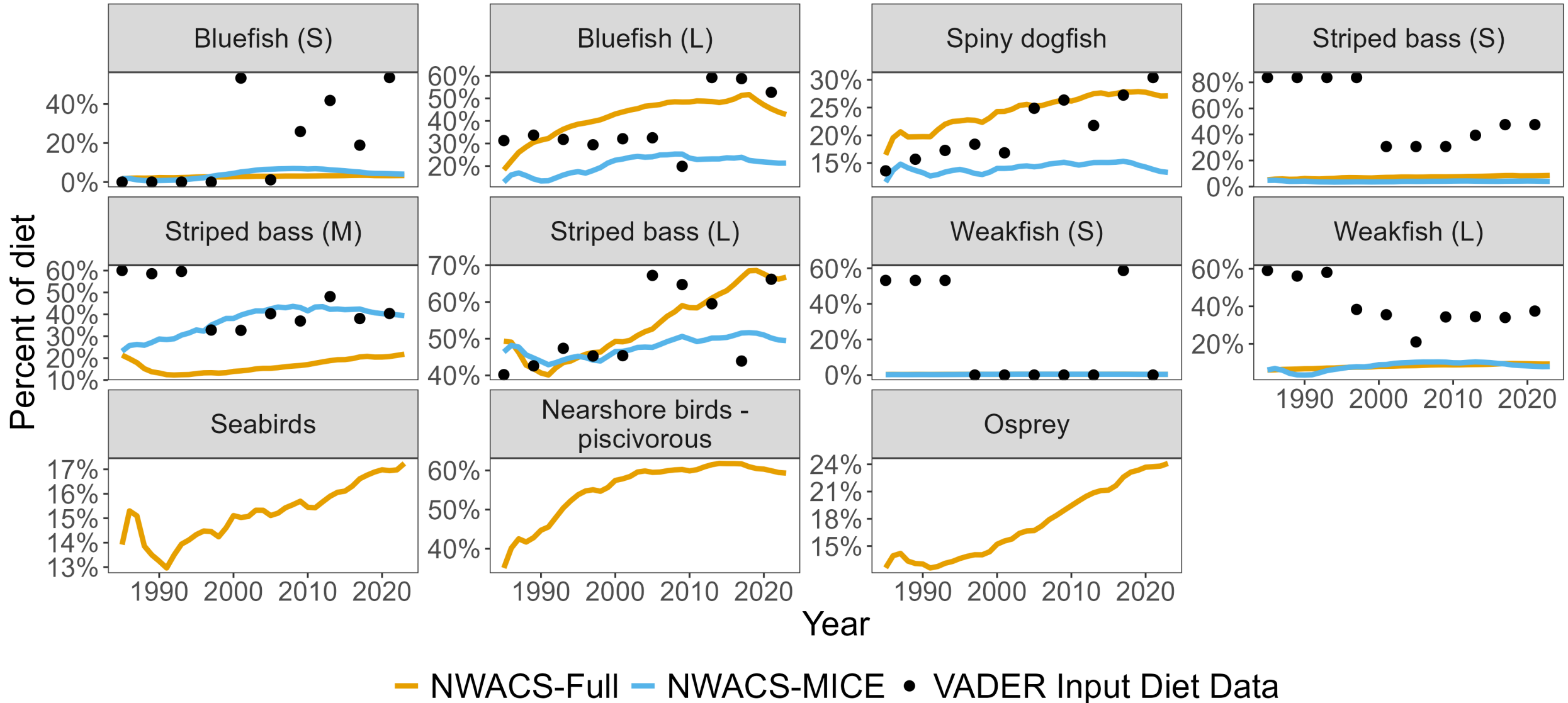


Figure 73. Estimates of M_2 (predation mortality) by stanza for Atlantic menhaden from the NWACS ecosystem models, 1985-2023.

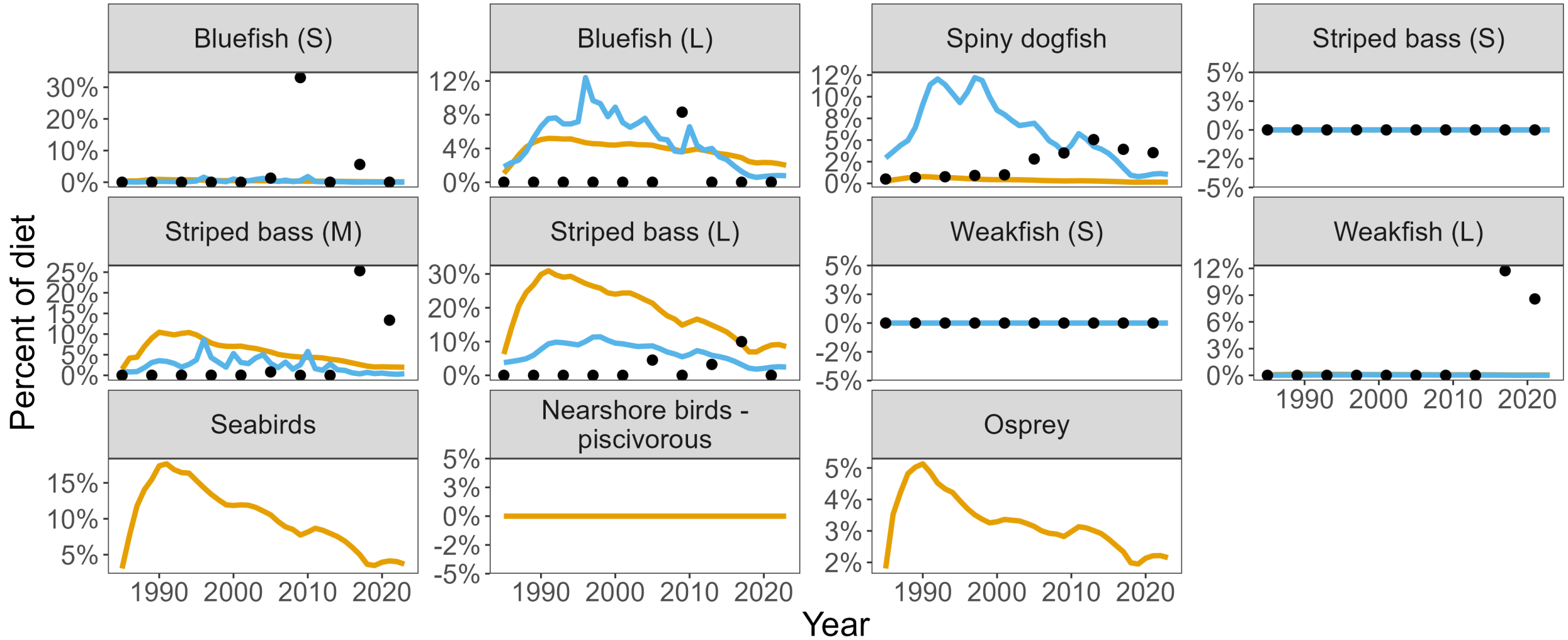
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Atlantic Herring and Diet Dynamics

- Both models projected a declining role of herring in predator diets, with greater variability in NWACS-MICE due to recruitment forcing.
- MICE predicted more herring in dogfish diets; FULL projected more in large striped bass diets.
- The MICE model included a **seasonal vulnerability forcing function**, moderating unrealistic herring consumption by striped bass.
- This function was excluded from FULL, leading to higher apparent herring dependence in striped bass diets.
- Seasonal dynamics and prey field differences significantly influenced diet trends across models.

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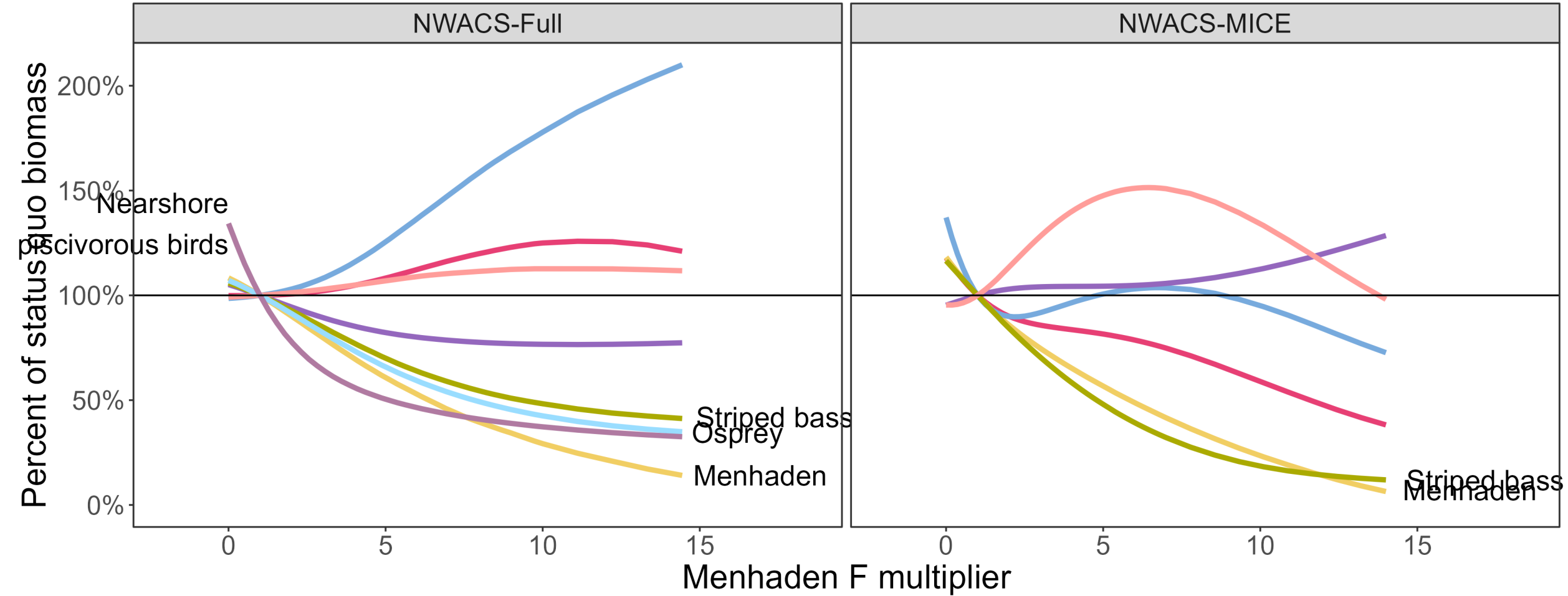


— NWACS-Full — NWACS-MICE • VADER Input Diet Data

Predator Responses to Menhaden F

- Striped bass were the most sensitive predator to increases in menhaden F; both models showed biomass declines at high F.
- Weakfish increased under higher F, though the shape of the response varied by model.
- Bluefish showed a positive response in FULL, but more nonlinear and negative in MICE.
- MICE predicted increases in dogfish and decreases in herring with rising F; FULL showed the opposite.
- These differences stem from structural features (e.g., seasonal egg production, prey switching, and vulnerability coefficients).

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- Atlantic herring
- Bluefish
- Striped bass
- Osprey
- Menhaden
- Spiny dogfish
- Weakfish
- Nearshore piscivorous birds

Management Implications and Ecological Resilience

- Results suggest that menhaden are **moderately sensitive** to changes in predator dynamics.
- Management has been conservative relative to both historical single-species targets and ERP thresholds.
- Even with higher F and lower biomass post-M revision, current TAC has low risk of exceeding ERP $F_{\text{THRESHOLD}}$.
- Generalist predator diets and a diverse forage base reduce dependency on menhaden alone.
- The ecosystem is not “wasp-waisted” like those cited in past global syntheses (e.g., Pikitch et al. 2012; Smith et al. 2011).

Menhaden Life History and Recruitment Dynamics

- Menhaden experience the highest predation mortality at ages 0–1, while the fishery targets ages 2+.
- Recruitment success, rather than adult abundance, determines menhaden availability to predators.
- Environmental variability, more than spawning biomass, drives recruitment, aligning with Hilborn et al. (2017) and Buchheister et al. (2016).
- Life history traits (e.g., early maturity, high fecundity, year-round spawning) buffer against environmental and fishing pressures.
- Most individuals spawn at least once before entering peak fishery selectivity.

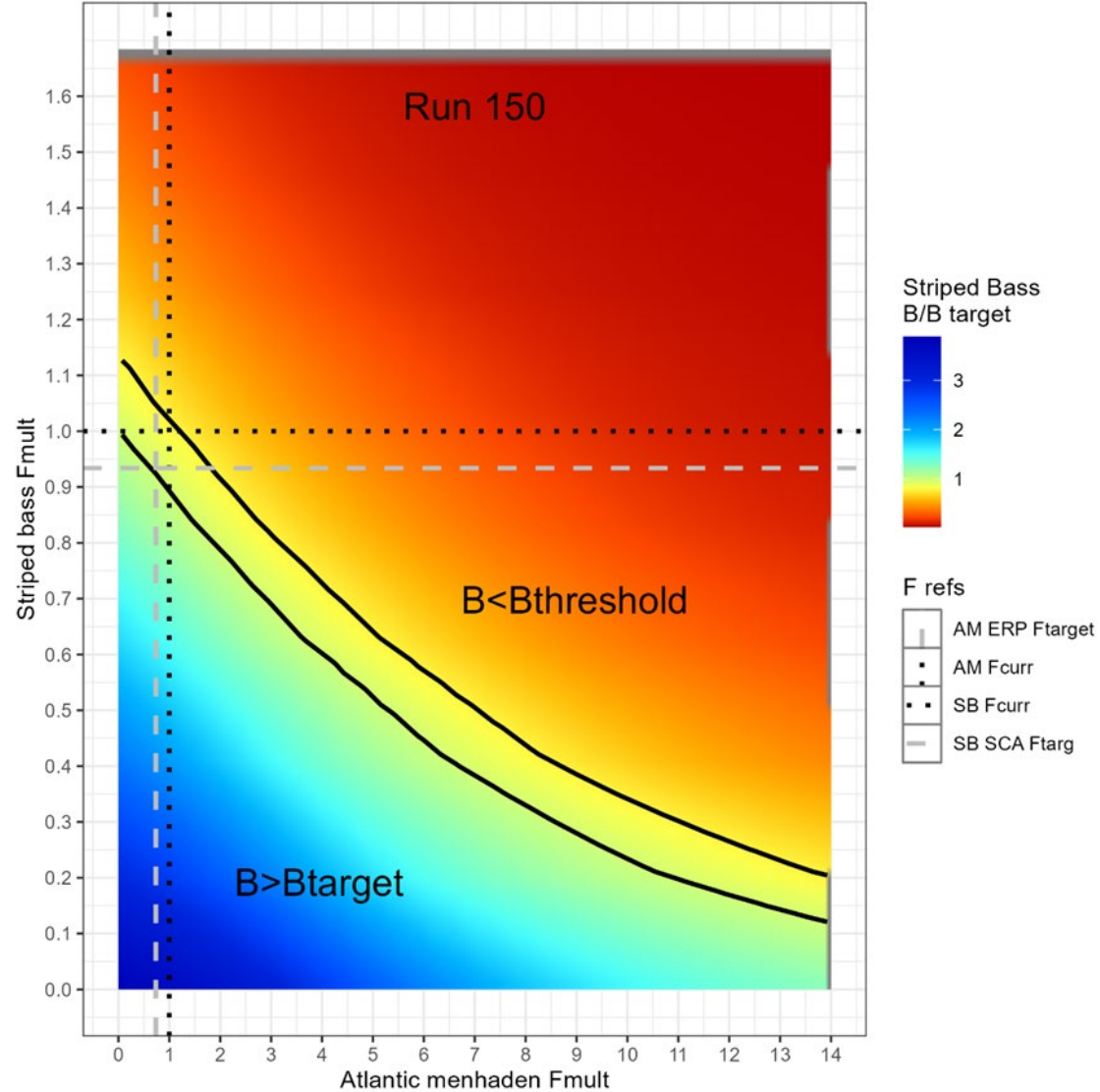
Spatial Considerations and Modeling Needs

- Current ERP models operate at a coastwide level and use seasonal overlap as a proxy for spatial structure.
- Key fine-scale interactions (e.g., predator-prey overlap in the Chesapeake Bay) are not explicitly modeled.
- Spatial effects are known to influence predator foraging success and localized prey depletion.
- Full spatial modeling remains a top priority for future assessments, managers, and stakeholders.

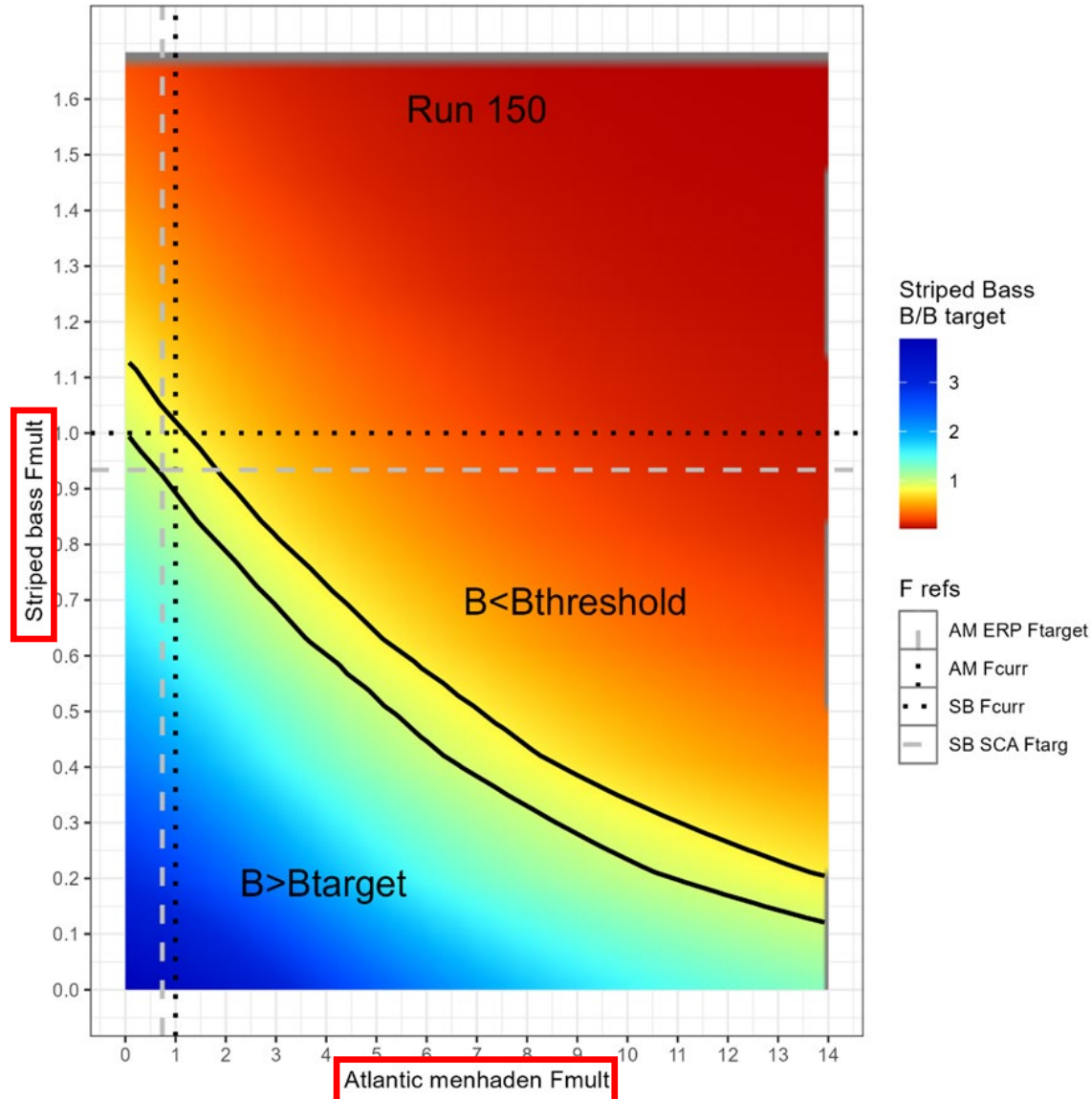
Management Advice and Trade-off Evaluation

- ERP WG supports continued use of BAM + NWACS-MICE to set harvest advice.
- BAM offers tactical advice; MICE quantifies ecosystem trade-offs and predator impacts.
- Surface plots enable managers to weigh predator and prey objectives.
- Translating between BAM and MICE introduces risk and uncertainty
- The ERP framework formalizes ecosystem trade-offs that were previously handled via ad hoc buffers.

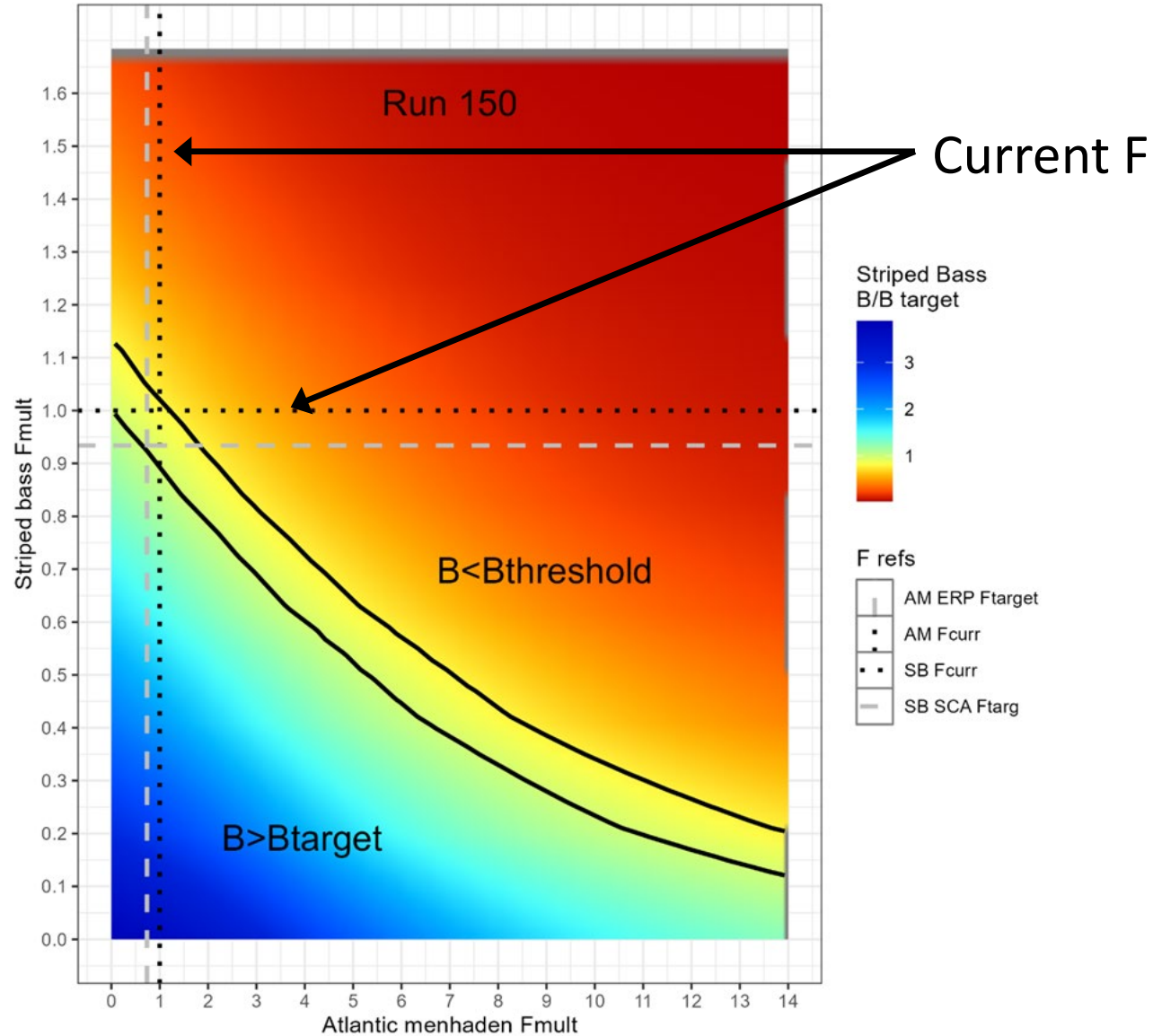
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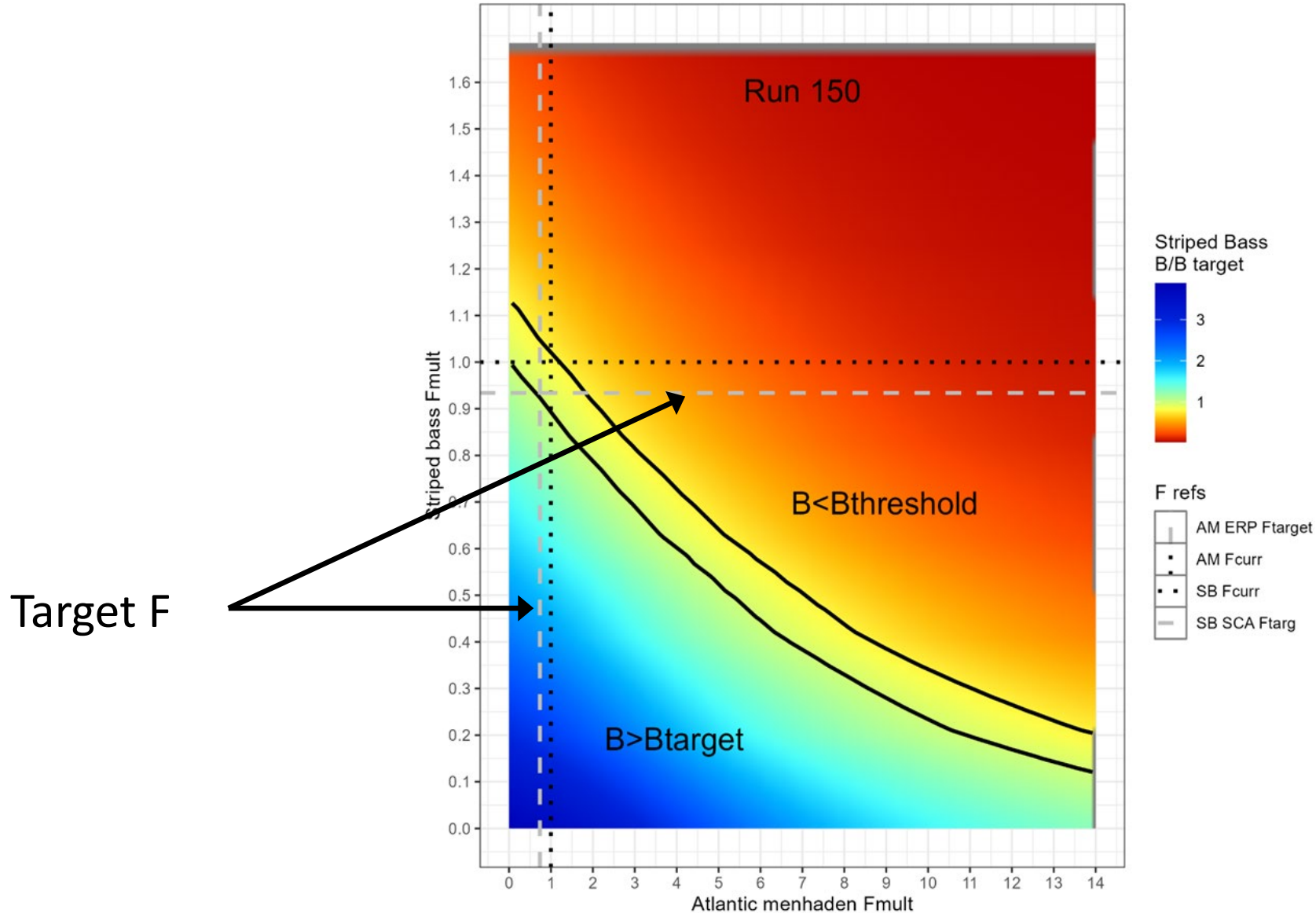
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