

## **Biomass dynamic models and external factor hypothesis testing**

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Note that a four index logistic biomass dynamic model (fishing only) was developed and rejected by the TC as implausible (stock at carrying capacity and very low F). This summary describes model development after that effort.

### Indices

Last time

One index.

MRFSS weight per trip 1981-2003.

Released fish and harvest mean weights based on harvest mean weight.

This time

Three indices

1. MRFSS weight per trip 1981-2006.

Released fish assigned headboat release weight (constant at 0.15 kg).

Harvested fish use harvest mean wt.

2. Two survey indices; mean wt confined to exploitable sizes (25 cm+)

2. Delaware trawl survey kg per trawl 1990-2006.

3. NJ August positive tows \* mean wt 1989-2006.

4. Indices standardized as Z transformation+2 for time period in common (1990-2006).

5. Indices compatible: positively correlate with each other, landings, converged portion of best previous VPA.

### Harvest from NMFS and MRFSS

#### Discards

Recreational (number discard estimate\*mortality\* mean wt).

Last time – 20% release mortality and mean wt = harvest wt.

This time – 10% release mortality and mean wt = head boat estimate (constant 0.15 kg).

#### Commercial

Last time – Annual discard ratio estimates.

This time – All year discard ratio estimates.

## External Factors

Based on previous analyses of environmental and predator/competitor candidates by Crecco or Uphoff.

Candidate external factors considered: striped bass, spiny dogfish, Atlantic croaker, bluefish, summer flounder, forage fish, sea temperature, NAO.

Selection of final candidates considered spatial-temporal overlap, diet information, statistical analysis, modeling.

## Previous Final External

Striped bass age 2+ biomass from VPA (1981 = 1982-1984 mean).

## Current Final External

Striped bass age 2+ biomass from ASMFC SCAM (1981 = 1982-1984 mean).

Menhaden age 1+ biomass from ASMFC forward projection.

## Hypotheses

Tested with 3 to 5 parameter models.

## Last time 3 hypotheses

1. Logistic production fc.
2. Fishing only (1 of 3).
3. Fishing + striped bass Type 3 predator-prey fc (2 of 3).
3. Fishing + striped bass compensatory fc; bass\*scalar (miss-labeled as Type 1 fc; 3 of 3).

## This time 12 hypotheses

1. Logistic and Gompertz production fc's with 6 variations each (2 fc\*6 external = 12).
2. Fishing only (1 of 6 external).
3. Fishing + Type 1-3 predator-prey fc (2-4 of 6 external).
4. Fishing + striped bass compensatory fc; bass\*scalar (5 of 6 external).
5. Fishing + compensatory as menhaden:bass fc (6 of 6 external); formalizes hypothesis developed in previous biomass dynamic predator-prey.

## Last time goodness of fit

SSQ, r-square, residuals, biology.

## This time goodness of fit

AICc added to above.

## Last time relative F vs model F

Harvest related losses / MRFSS index rescaled to Converged VPA (Crecco's rescaled relative F).

## This time relative F vs model F

(Harvest related losses \* model index scalar) / mean Z+2 index.

Crecco's rescaled relative F can be added once finalized.

Implemented in spreadsheet with Evolver genetic algorithm (Palisade Corporation) both assessments.

Minimize lognormal error in predicted and observed indices.

#### Output

F, predation/competition losses, nonequilibrium M, biomass, surplus production, production, equilibrium and non-equilibrium reference points.

Projections can be made.