Recreational Seasonal Closures:

Tradeoffs and uncertainties due to species seasonality and angler effort dynamics

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NATURE COAST BIOLOGICAL STATION

SCHOOL OF FOREST, FISHERIES, AND GEOMATICS SCIENCES

Background & Motivation of the Study

Conducted from 2016-2018

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Modeling temporal closures in a multispecies recreational fishery reveals tradeoffs associated with species seasonality and angler effort dynamics

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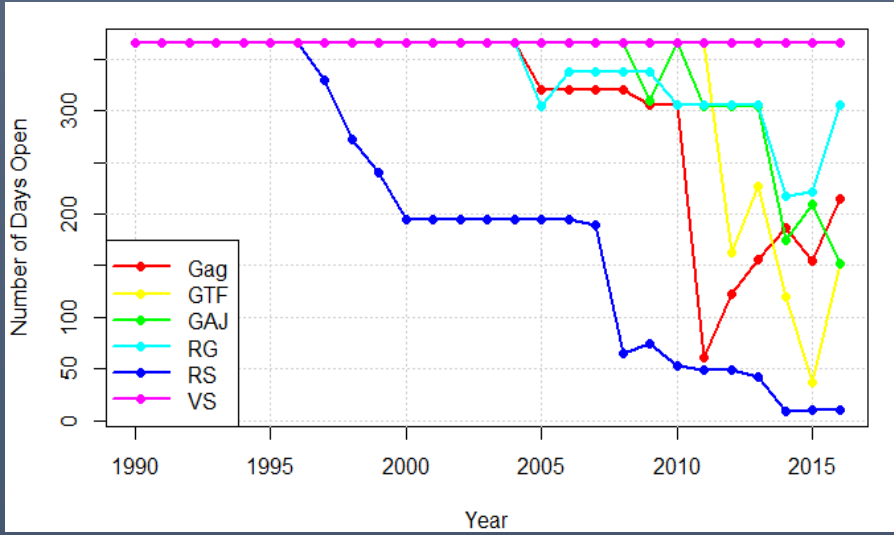
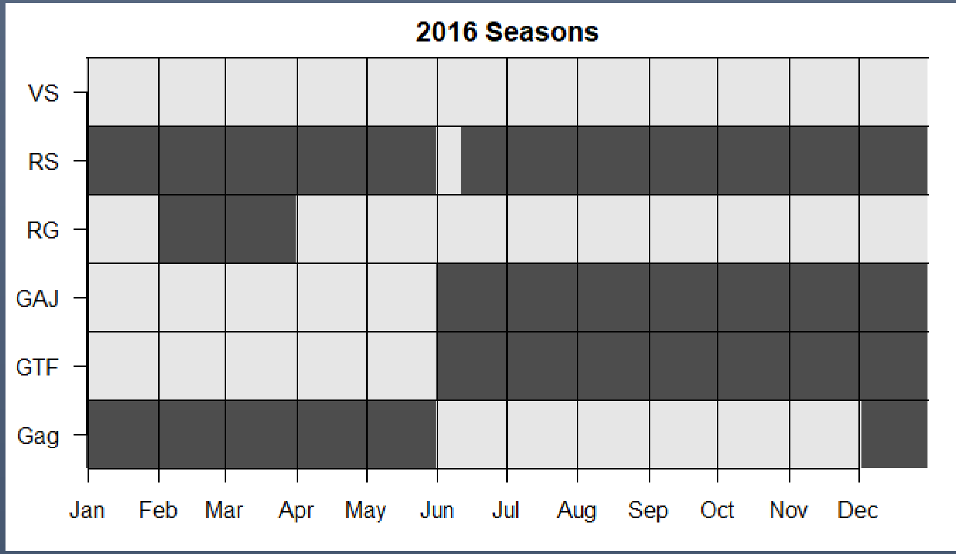
<u>Goal:</u> To examine whether a bottom reef fish season for the GoM private recreational sector would result in conservation gains and expanded fishing opportunities.

Background & Motivation of the Study



Recreational harvest seasons have generally become shorter…



…there is little overlap among reef fish open seasons, allowing discarding to continue

How can we better control or consolidate effort to reduce discards and increase allowable harvest?

Harvest closures vs. Fishing closures

Harvest closure – illegal to posses a species during the closed season; does not necessarily limit effort

Fishing closure – prohibits use of some or all gear types during the closed season;

We examined a '**bottom fishing**' closure, which would temporarily prohibit recreational fishing with hook & line on the seafloor in reef habitats.

Consideration #1: Angler effort response

What would anglers do if a 'bottom fishing' closure were implemented?

Short Term Response

- Go bottom fishing at different time of the year (effort displacement)
- Target different suite of species during the closure (species shifting)
- Choose to take fewer trips (effort loss)
- Continue to fish anyway (noncompliance)

Long Term Response

Take more trips per year as stocks increase, and vice versa.

What other attributes drive fishing effort?

Consideration #2: Seasonal Patterns

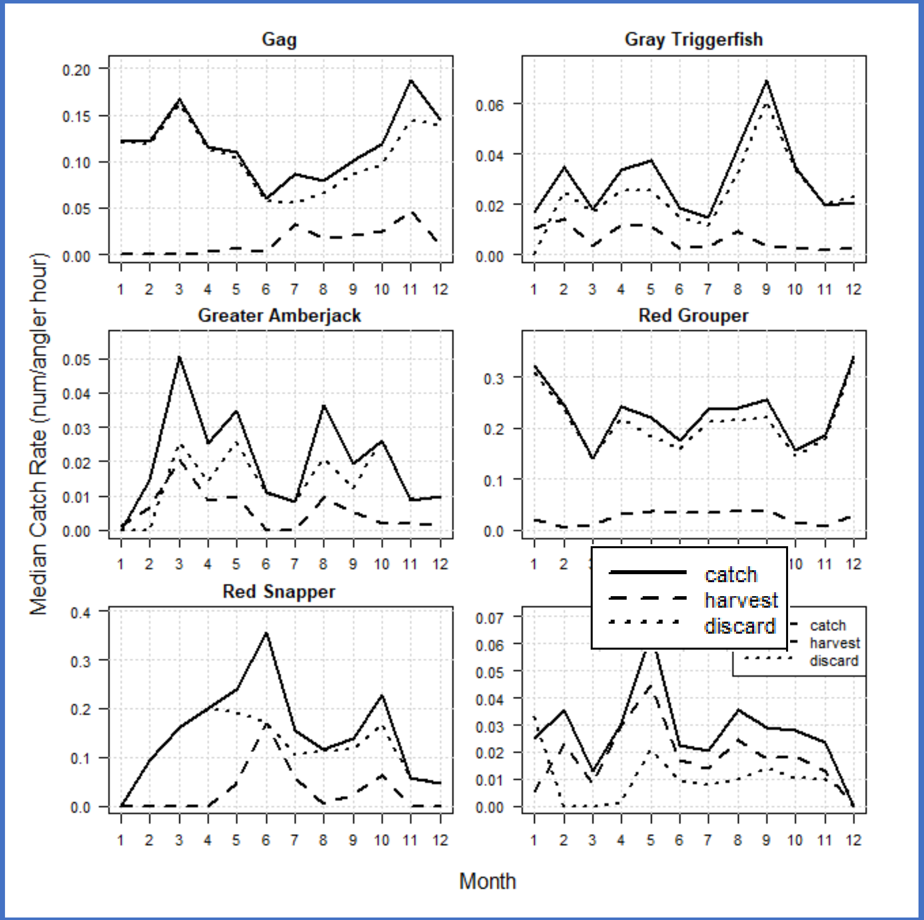
Timing matters…

Some species may be more “available” or easier to target/catch during certain months

Contrasting patterns in groupers & snappers

Combined with effort displacement, this may have unintended consequences

MRIP median monthly catch rates (fish/angler hour)



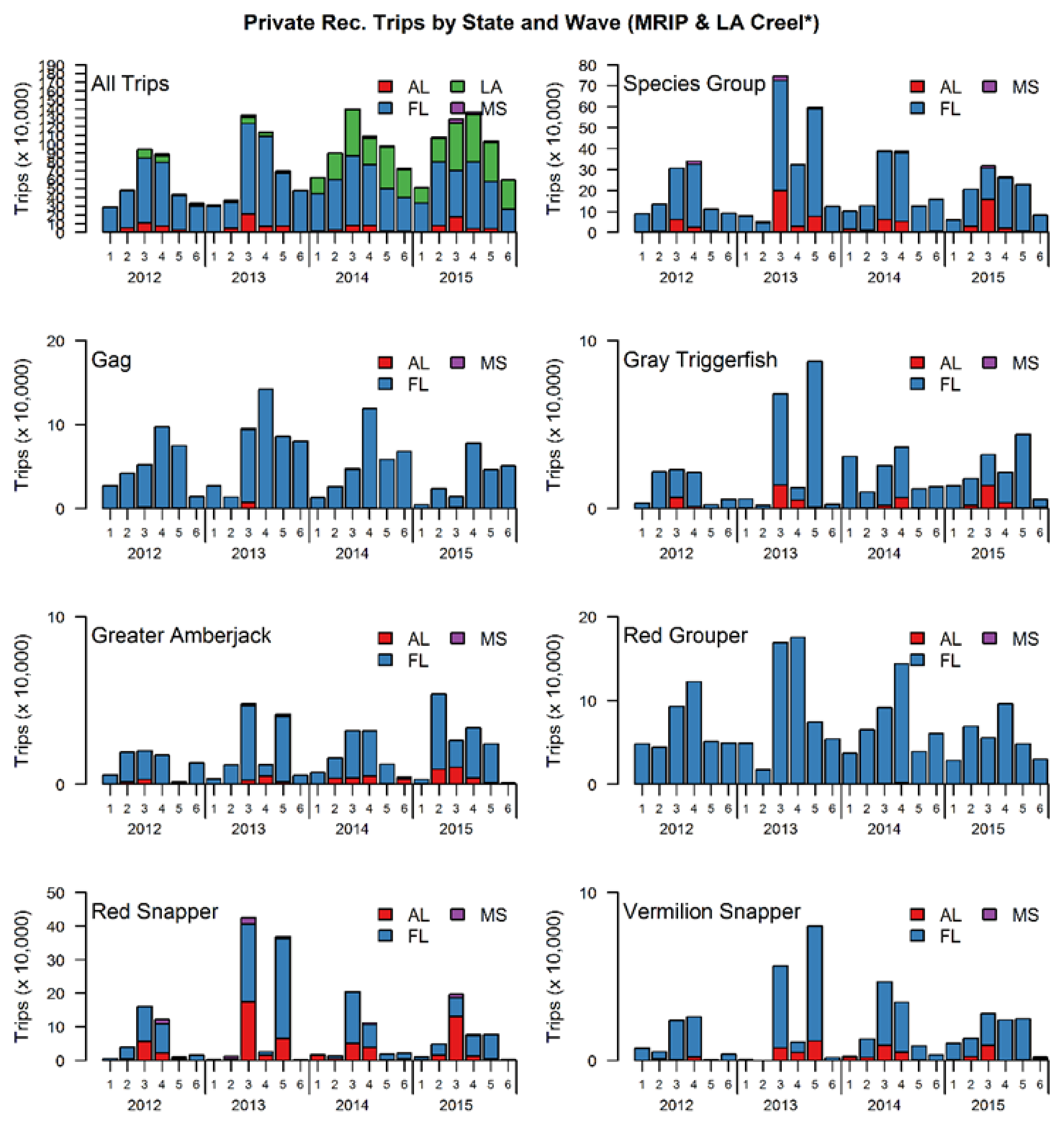
Consideration #2: Seasonal Patterns

Timing matters…

Effort is highest in waves 3 & 4 - May through August

Summer closure might have severe socio-economic consequences

Winter closure might be ineffective



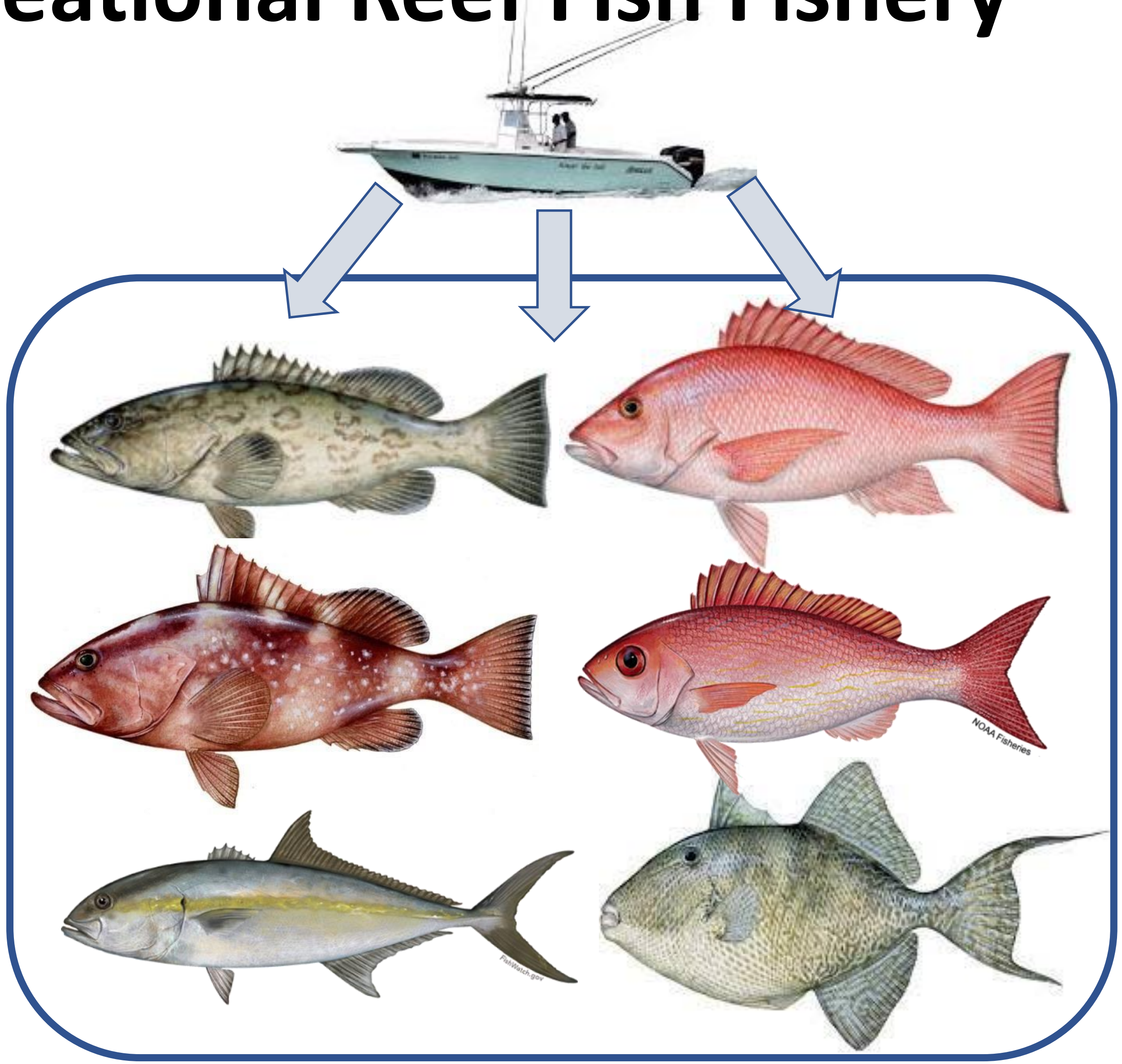
A Multispecies Model to Evaluate Bottom Fishing Closures in the GoM Recreational Reef Fish Fishery

Multiple age-structured projection models linked together with monthly effort dynamic model for private rec fleet

- gag, red snapper, red grouper, greater amberjack, gray triggerfish, vermilion snapper

Inherits all selectivity, S-R, and biological parameters from SEDAR stock assessments

Allows us to implement closures of one or more months and estimate changes in population size, harvest, discards, and fishing effort.



Multispecies Age-structured Simulation Model

<u>Important Limitations:</u>

1) Can only model closures in addition to existing (2012-2015) species-specific harvest closures

   - no catch rate data for an *"all open"* scenario;

1) Single-species harvest seasons were fixed, and do not adapt to changes in stock status

   - adaptive management would require modeling a complex structured decision-making process

Multispecies Age-structured Simulation Model

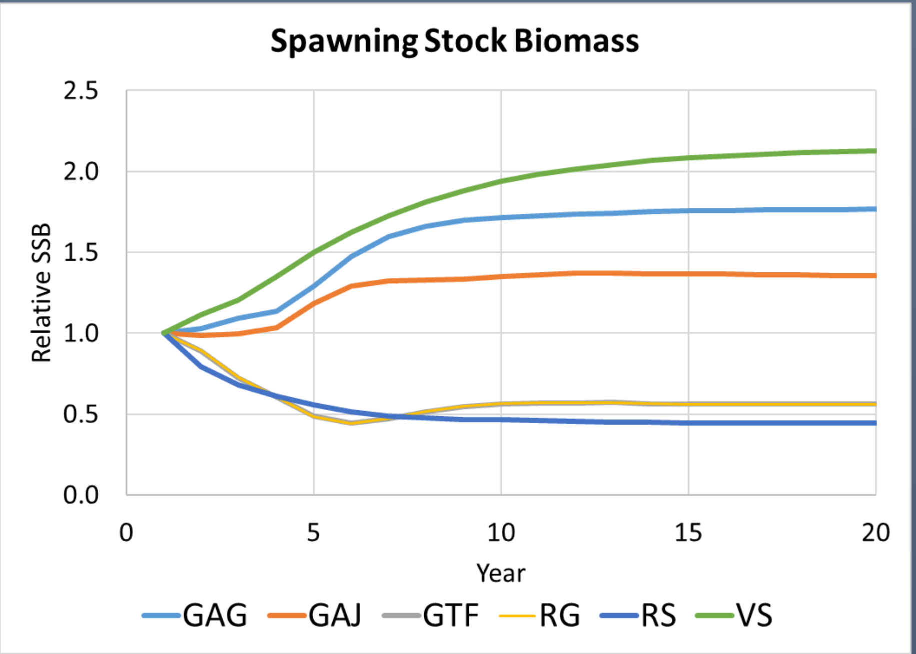
Numbers at age projected for 20 years using standard, annual age-structured equations

Fishing mortality rate partitioned into retention (F^R) and dead discards (F^D) for private recreational fleet

- F held constant at terminal year est. for all other fleets

Private recreational F simulated with effort dynamic model assuming a baseline species-specific catchability coefficient, q

$$q = \frac{\text{F from assessment}}{\text{MRIP observed trips}}$$



$$N_{a=0,y+1} = \frac{4hR_0SSB_y}{SSB_0(1-h) + SSB_y(5h-1)}$$

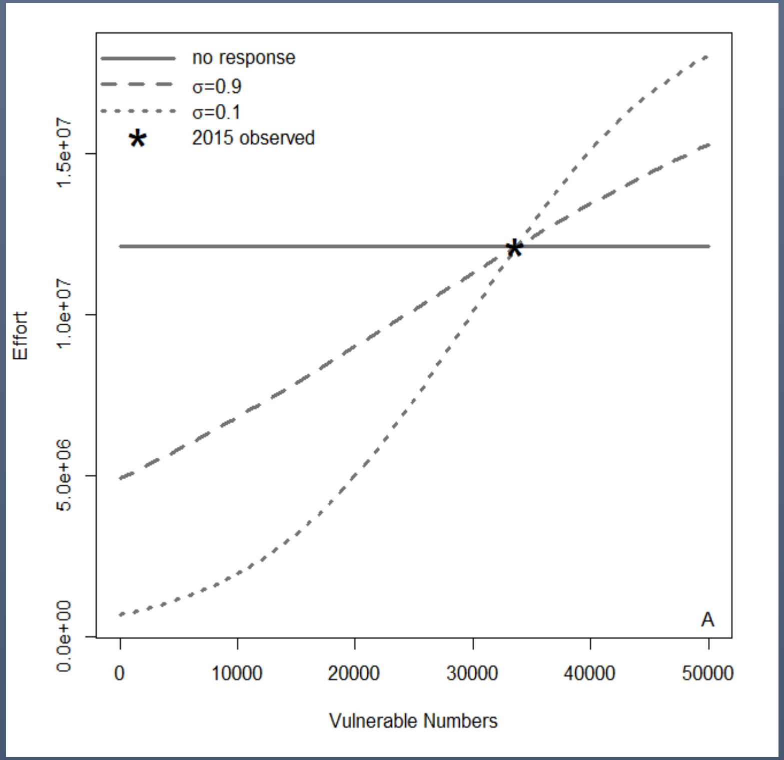
$$N_{a+1,y+1} = N_{a,y} \cdot \exp\left(-\left(M_a + F_y^R V_a^R + F_y^D V_a^D + \sum_{f=1}^{n} F_f V_{a,f}\right)\right)$$

$$F_y^R = \sum_m q_{m,y}^R \acute{E}_{m,y} \qquad F_y^D = \sum_m q_{m,y}^D \acute{E}_{m,y}$$

Effort Dynamic Model

<u>Long-term Response:</u> Effort in each year is predicted as a function of fish abundance in the prior year, summed over all species

- No response, moderate σ=0.9, and fast σ=0.1
- Annual effort distributed proportionately to months based on observed monthly effort



To simulate a seasonal closure, assign each month status 0/1

$$\acute{E}_{y+1} = 1/\left(1 + e^{(VN_h - VN_y)/\sigma VN_h}\right) \cdot E_{max}$$

<u>Short –term Response:</u> Some fraction (**λ**) of affected trips ($A_{m,y}$) are allowed to redistribute to open months

$$\acute{E}_{m,y} = \acute{E}_y \cdot \frac{E_{m,y}}{\sum_y E_{m,y}}$$

- **λ** is unknown - low values imply effort loss and/or species shifting, values close to 1 imply effort displacement
- Evaluated closure scenarios over **λ** values from 0-1 by 0.25

$$\acute{E}_{m,y} = \left(\lambda \sum_m A_{m,y}\right) \frac{E_m^{s=1}}{\sum_m E_m^{s=1}} + \acute{E}_{m,y} \cdot s_m$$

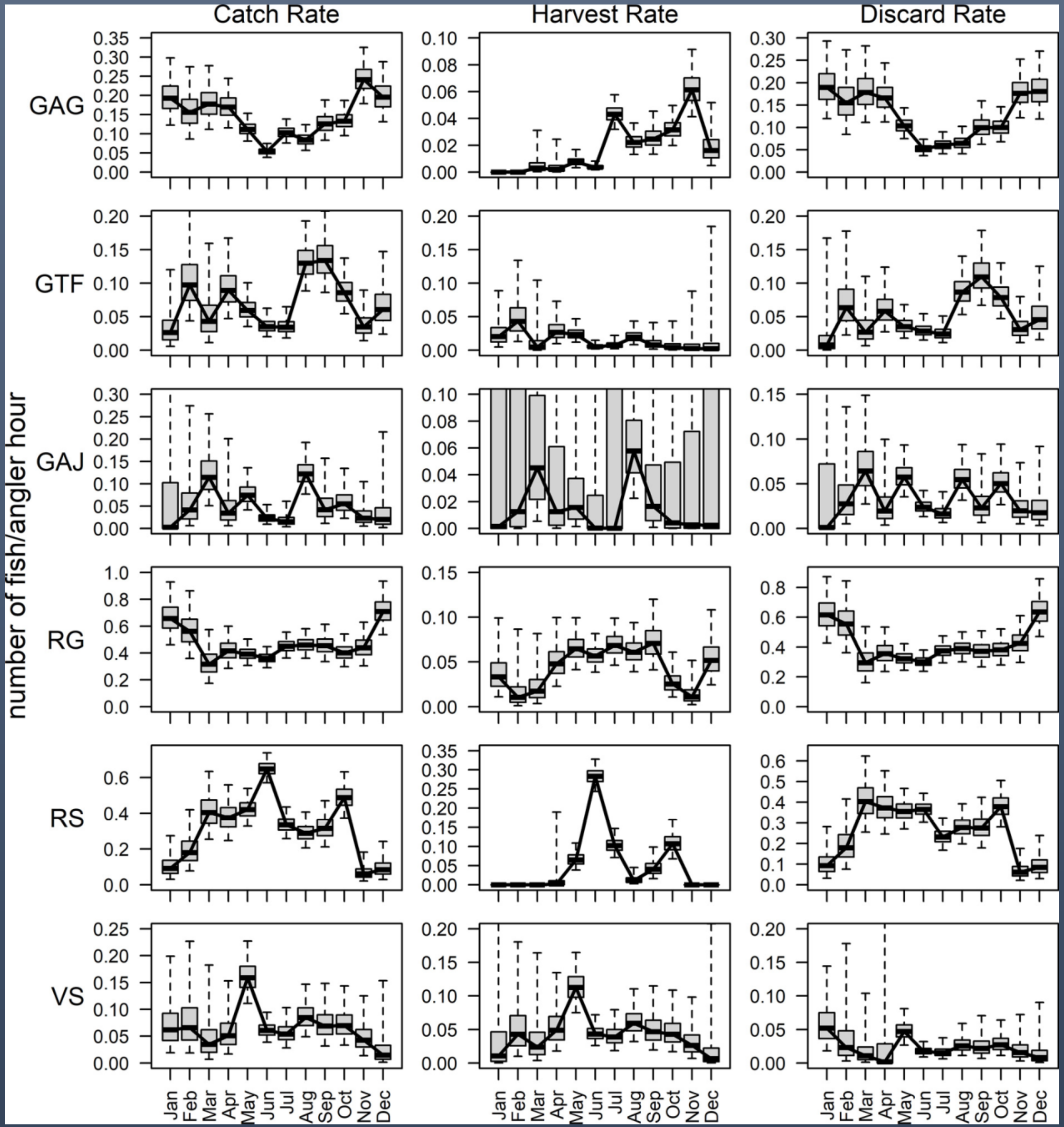
Incorporating Species Seasonality

Monthly catch, harvest, and discard rates estimated from 2012-2015 MRIP data using GLM model

Mean-scaled monthly harvest and discard rates multiplied by baseline *q* to arrive at q_m for each species

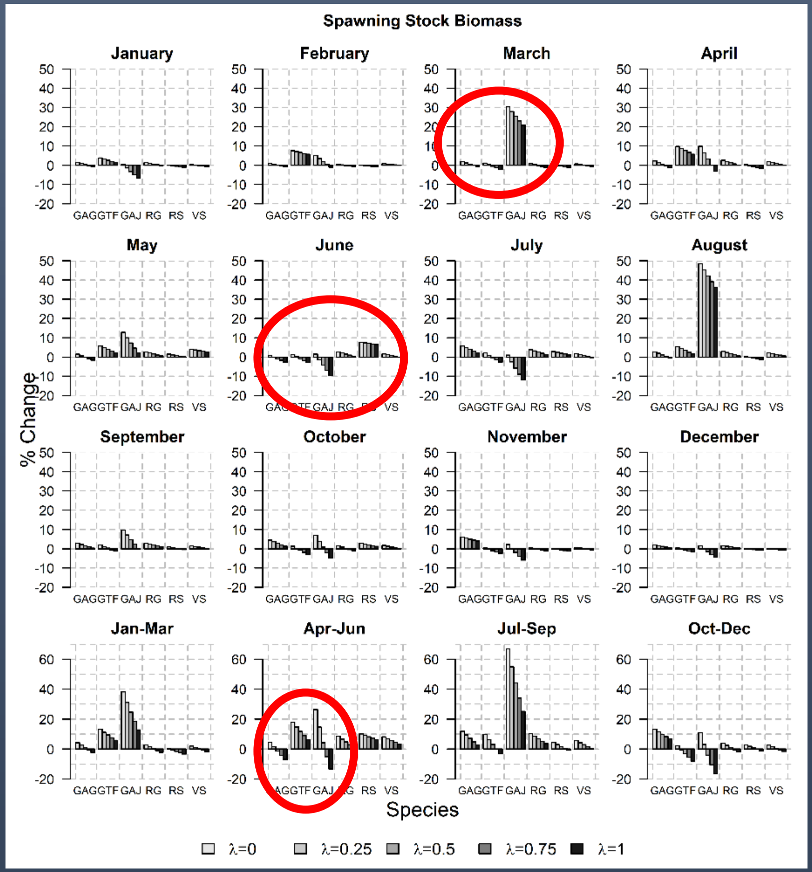
$$F_y^R = \sum_m q_{m,y}^R \acute{E}_{m,y} \qquad F_y^D = \sum_m q_{m,y}^D \acute{E}_{m,y}$$

Allows F_y to change with monthly effort and species-specific monthly catchabilities



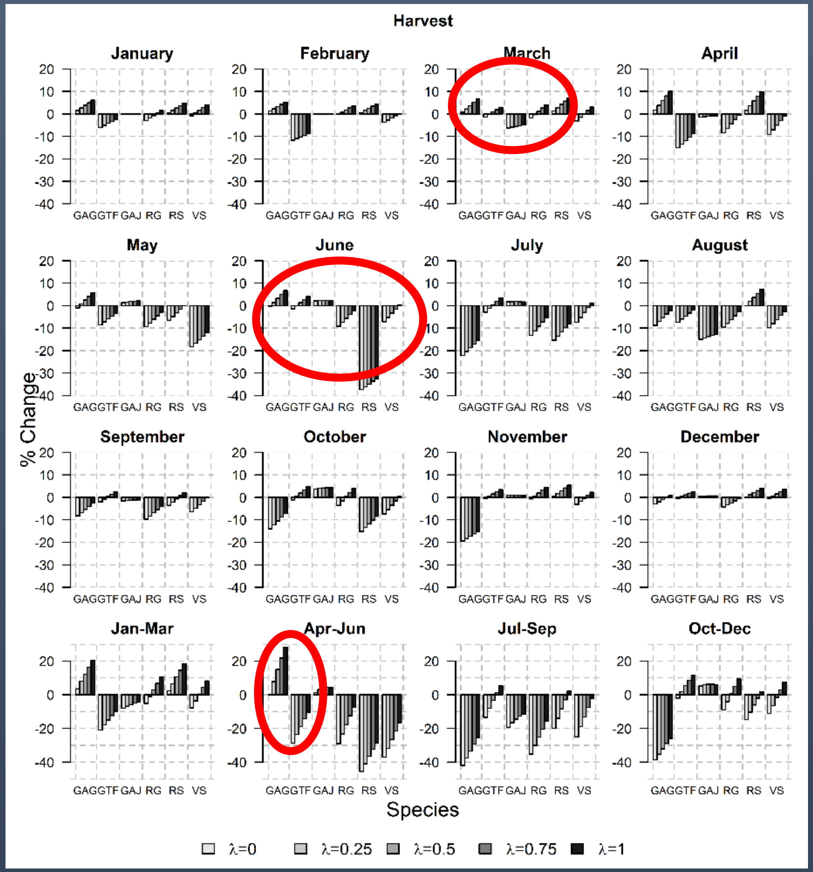
Age-structured Model Results & Tradeoffs

SSB increased the most when closures coincided with high catch rates and λ was low



Tradeoffs occurred in almost all scenarios

Likewise, harvest was usually reduced under the seasonal closures, but not always



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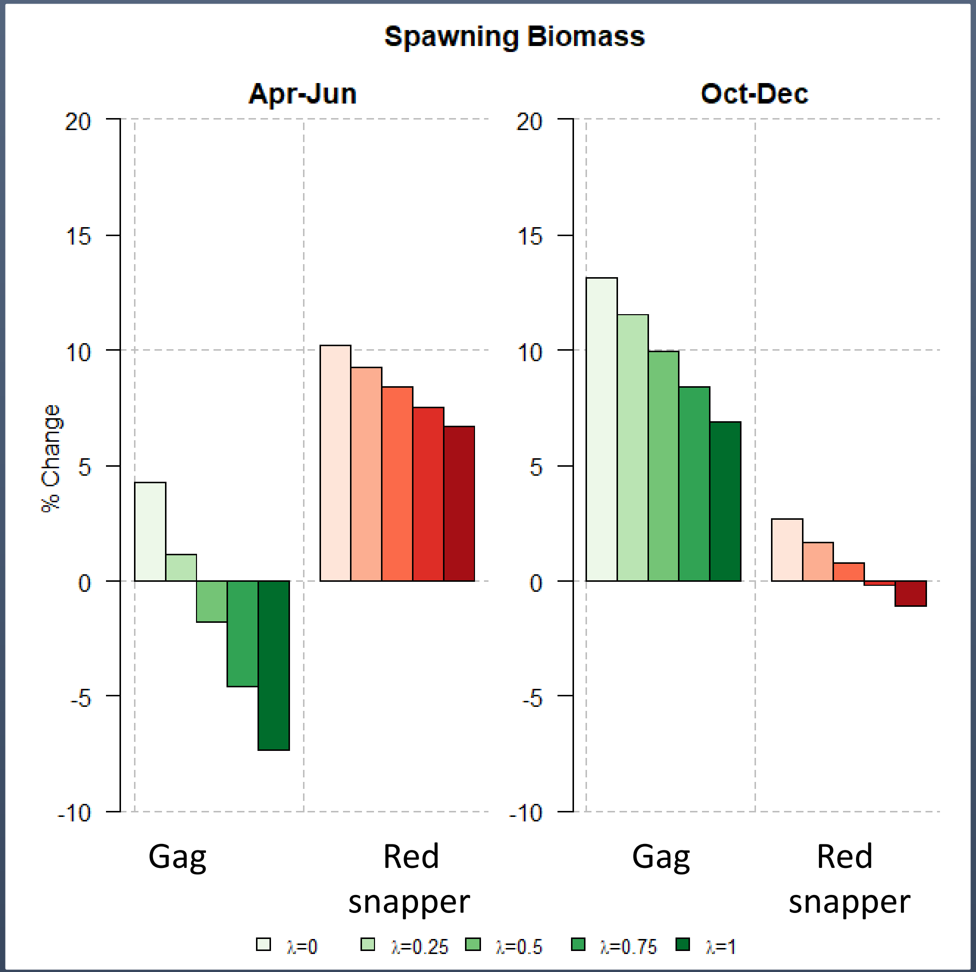
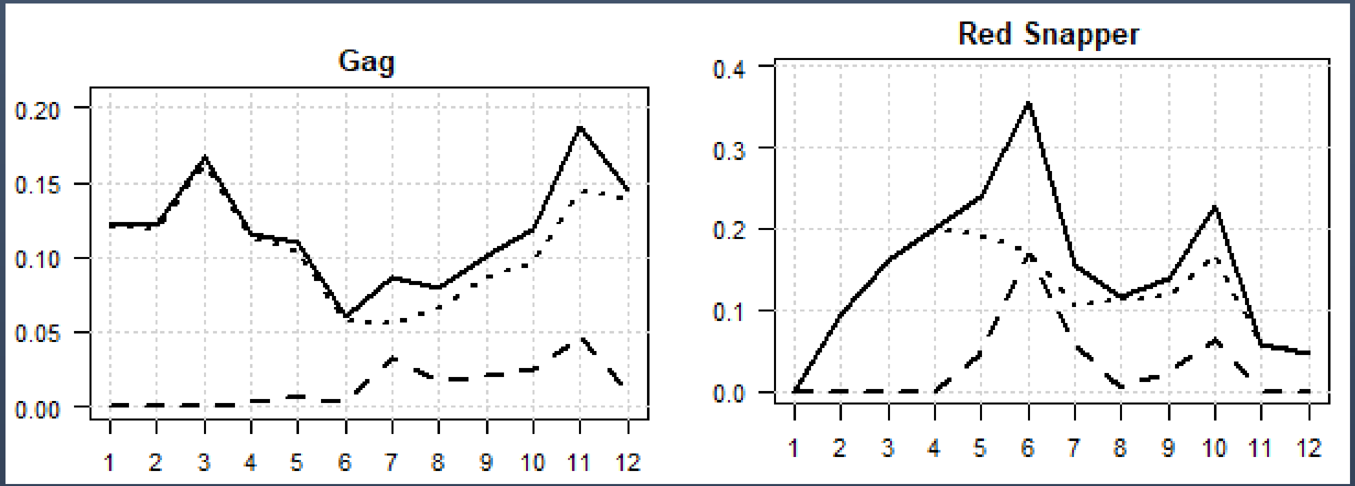


Spring vs Fall Closure on Gag and Red Snapper

When λ is high, affected trips pile into months with higher catch rates, causing a net increase in harvest and declines in biomass

MRIP Monthly Catch Rates



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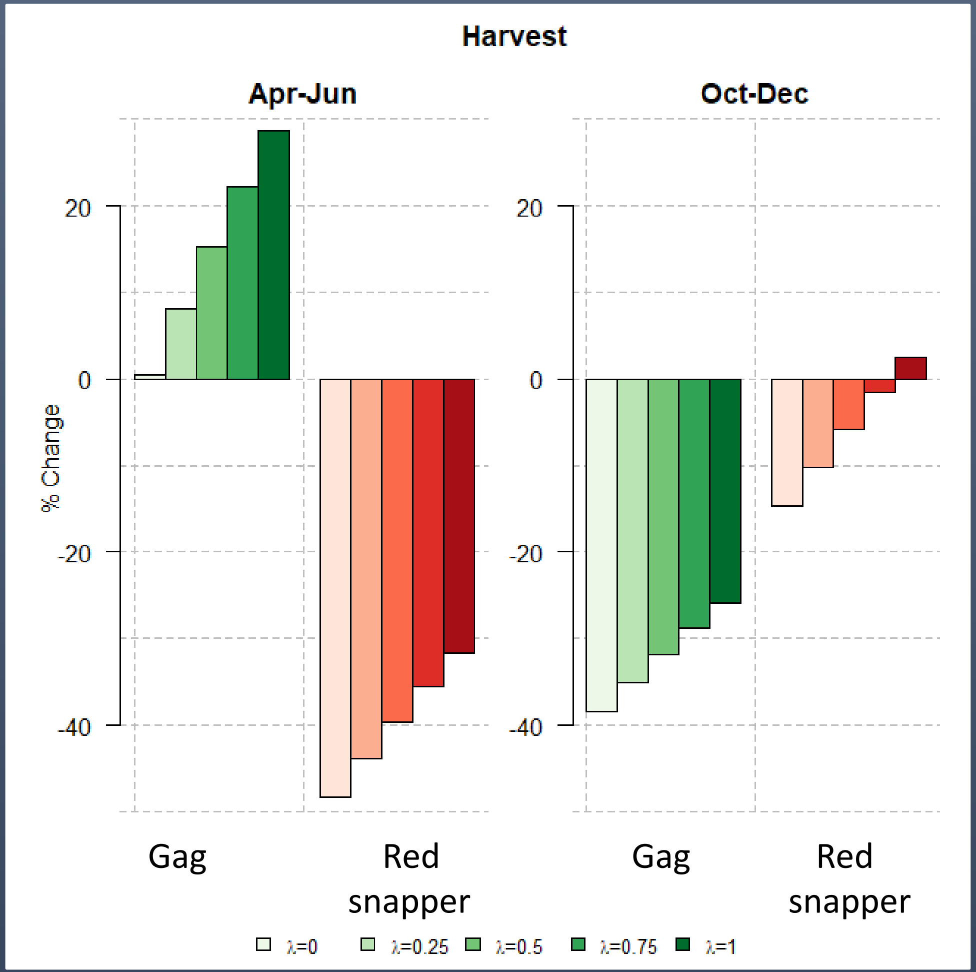

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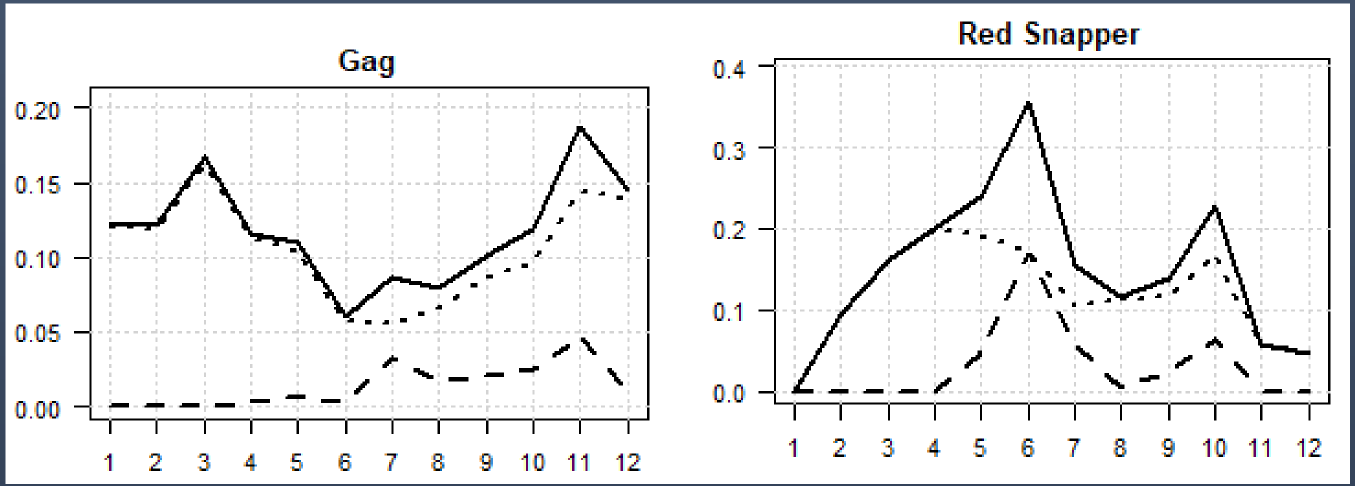

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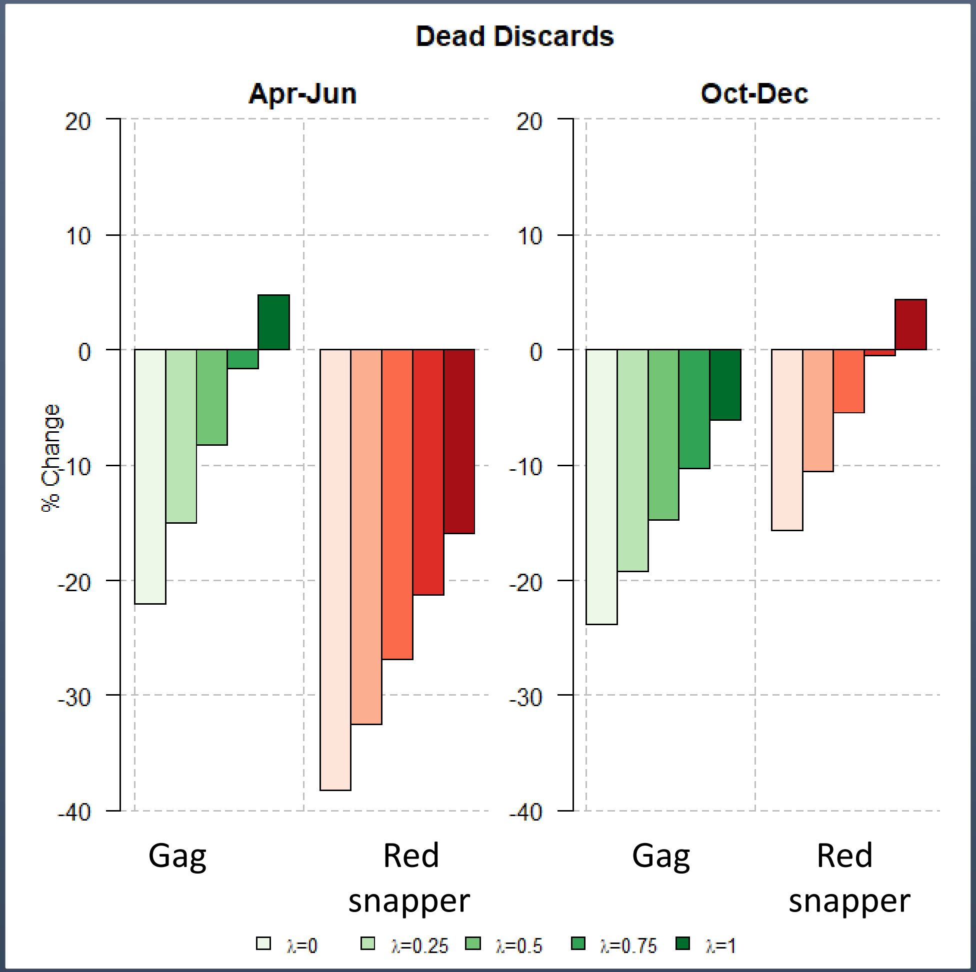

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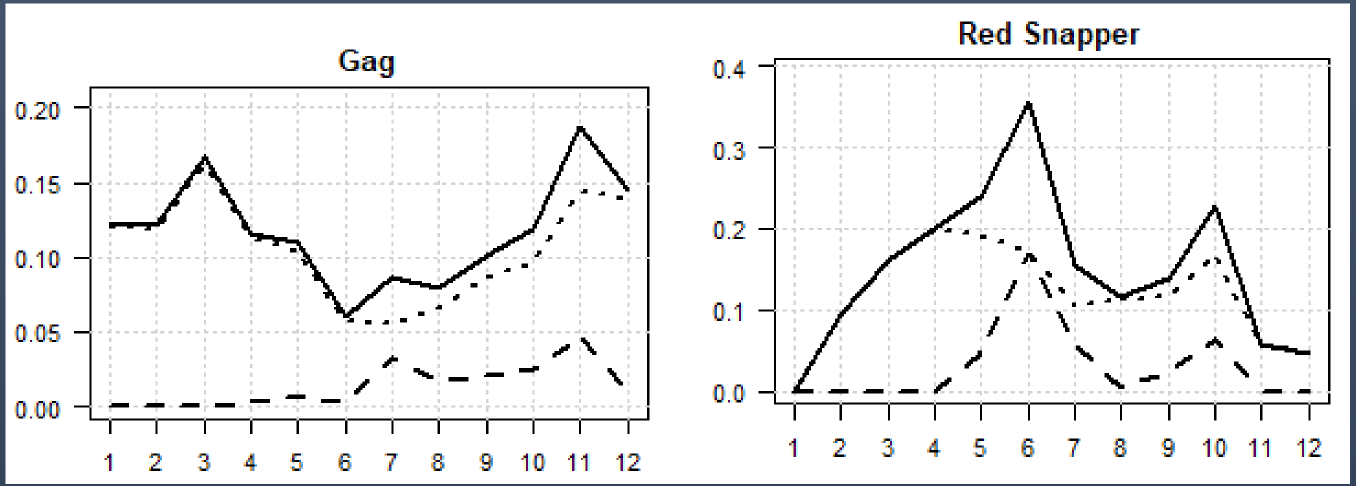


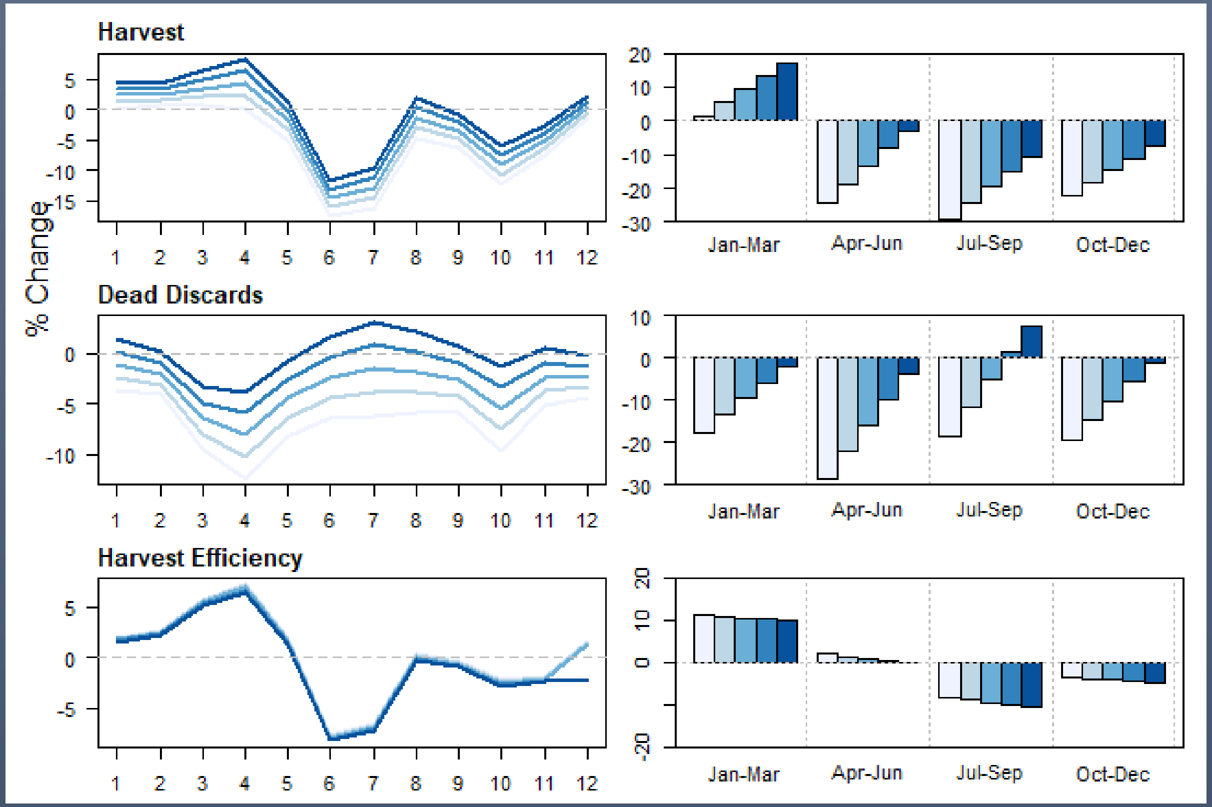
Age-structured Model Results & Tradeoffs

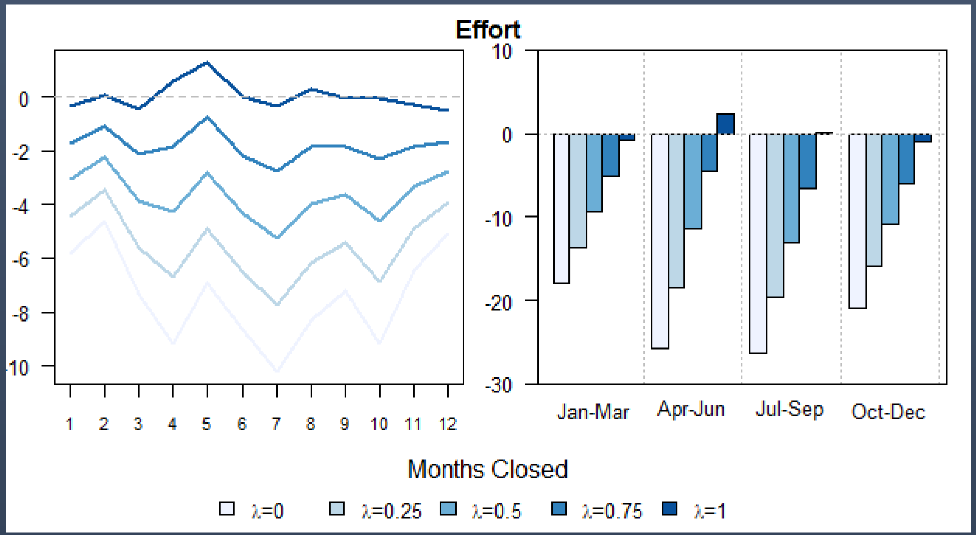
Closures occurring in late winter and early spring (March & April) successfully reduced discards and improved harvest efficiency. Potentially Aug-Sep as well.

- harvest efficiency = harvest/total killed

Net increase in total abundance allowed effort to increase, creating more fishing opportunities over the long term.

However, a fast effort response mitigated any SSB gains achieved by the bottom fishing closure.





Summary, Conclusions, & Recommendations

1. Results were very sensitive to angler response assumptions (σ, λ) – “choice experiments” are needed to understand angler decision making.

2. Timing of any scenario is likely to have disproportionate impacts across all species – this is exacerbated by effort displacement.

3. Any scenario must be weighed against the socio-economic tradeoffs as impacts are likely to be intense and broad – regional economic impact analyses and stakeholder buy-in are needed.

4. Closures in late winter/early spring and late summer/early fall showed potential to reduce dead discards while minimizing tradeoffs in harvest, SSB, and effort loss.

5. Further model development (with mgmt. input) needed to evaluate bottom fishing closures along with alternative single-species harvest seasons

Thank you!

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NOAA FISHERIES

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Questions?

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