



SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

Red Drum Stock Status

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Live Life Outdoors

Stock Synthesis Reference Points



Stock Synthesis Reference Points

Overfishing – Defined in current Interstate FMP

Threshold = $SPR_{30\%}$ ($F_{30\%}$)

Target = $SPR_{40\%}$ ($F_{40\%}$)



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Threshold = $SPR_{30\%}$ ($F_{30\%}$)

Target = $SPR_{40\%}$ ($F_{40\%}$)

Note: $F_{xx\%}$ defined as the age-2 fishing mortality associated with $SPR_{xx\%}$ given terminal year selectivity patterns



Stock Synthesis Reference Points

Overfishing – Defined in current Interstate FMP

Threshold = $SPR_{30\%}$ ($F_{30\%}$)

Target = $SPR_{40\%}$ ($F_{40\%}$)

Overfished – Not currently defined in Interstate FMP

Threshold = $SSB_{30\%}$

Target = $SSB_{40\%}$

Note: $F_{xx\%}$ defined as the age-2 fishing mortality associated with $SPR_{xx\%}$ given terminal year selectivity patterns



Stock Synthesis Reference Points

Overfishing – Defined in current Interstate FMP

$$\text{Threshold} = \text{SPR}_{30\%} (F_{30\%})$$

$$\text{Target} = \text{SPR}_{40\%} (F_{40\%})$$

Note: $F_{xx\%}$ defined as the age-2 fishing mortality associated with $\text{SPR}_{xx\%}$ given terminal year selectivity patterns

Overfished – Not currently defined in Interstate FMP

$$\text{Threshold} = \text{SSB}_{30\%}$$

$$\text{Target} = \text{SSB}_{40\%}$$

Status Determination – terminal year status based on 2019-2021 3-yr avg.

Used three-year running averages...

$$\text{Overfishing} = \overline{\text{SPR}_{y-2,y-1,y}}$$

$$\text{Overfished} = \overline{\text{SSB}_{y-2,y-1,y}}$$



Traffic Light Analysis Reference Points & Management Triggers



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Overfishing

Fishery performance red in any of the past 3 years



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Overfished

Adult abundance red in any of the past 3 years



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Note: Reference points not defined in current Interstate FMP; reference points developed by SAS in the current assessment



Traffic Light Analysis Reference Points & Management Triggers

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Fishery performance red in any of the past 3 years

Overfished

Adult abundance red in any of the past 3 years

Additional Management Action Triggers from TLA

Fishery performance **yellow in any of the past 3 years** and recruitment is **red for 5 consecutive years** (a generation of the vulnerable population)

Consistent below average recruitment and increasing catch and/or decreasing sub-adult abundance

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Fishery performance **yellow in any of the past 3 years** and recruitment is **red for 5 consecutive years** (a generation of the vulnerable population)

Consistent below average recruitment and increasing catch and/or decreasing sub-adult abundance

Both fishery performance and adult abundance in **any of the past 3 years are yellow**

Stock is experiencing increasing catch and/or decreasing sub-adult abundance which is leading to declines in adult abundance

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Traffic Light Analysis Reference Points & Management Triggers

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Fishery performance red in any of the past 3 years

Overfished

Adult abundance red in any of the past 3 years

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Additional Management Action Triggers from TLA

Fishery performance **yellow in any of the past 3 years** and recruitment is **red for 5 consecutive years** (a generation of the vulnerable population)

Consistent below average recruitment and increasing catch and/or decreasing sub-adult abundance

Both fishery performance and adult abundance in **any of the past 3 years are yellow**

Stock is experiencing increasing catch and/or decreasing sub-adult abundance which is leading to declines in adult abundance

Recruitment is **red for 5 consecutive years** and adult abundance is **yellow in any of the past 3 years**

Consistent below average recruitment representing concern for the future of the adult abundance



Skate Analysis

No formal reference points developed, but application suggests some measures indicative of stock status with regards to...

Fishery Performance

Catch/Index – ratio of the 3-yr moving average of total catch divided by the 3-yr moving average of an independent index

Relative F – median recommended F based on the catch/index ratio

Catch Reduction

%_{Reduction} – recommended reduction in catch when a stock is deemed to experience unsustainable exploitation based on catch/index compared to Relative F



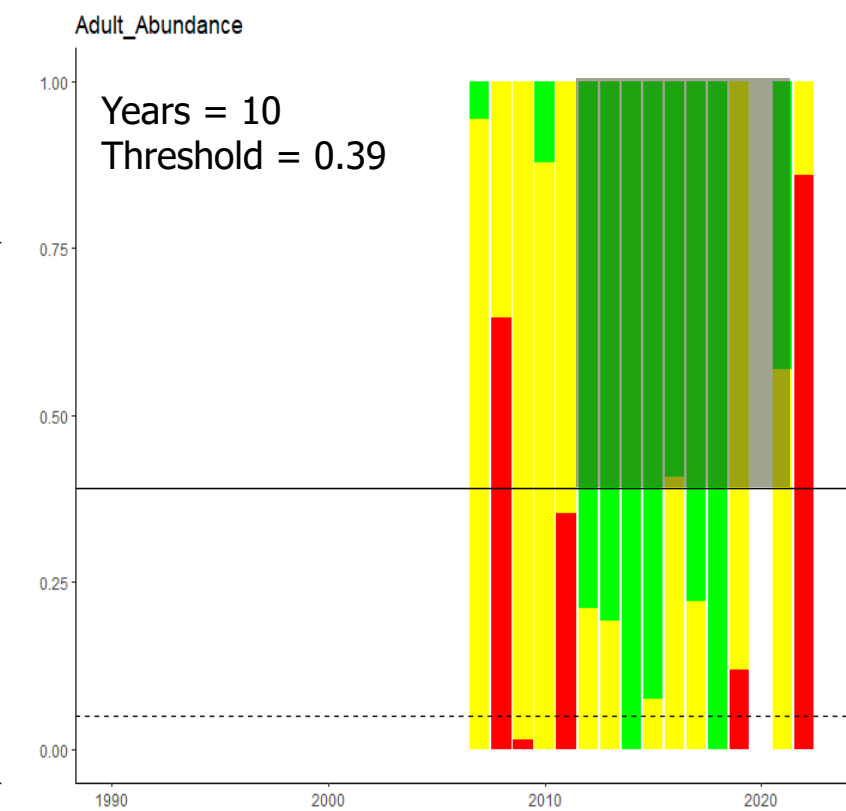
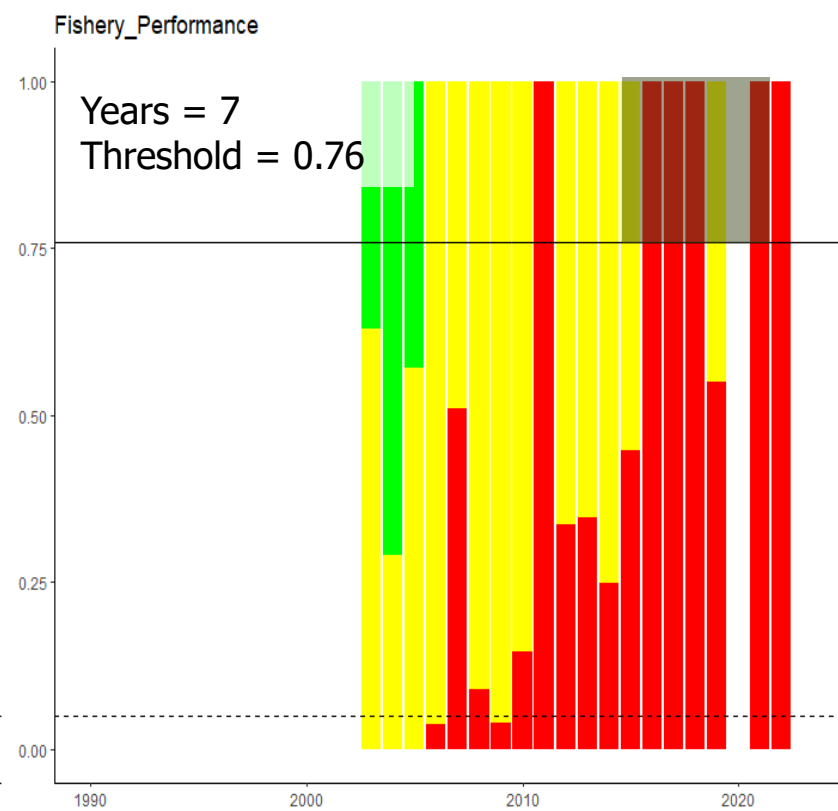
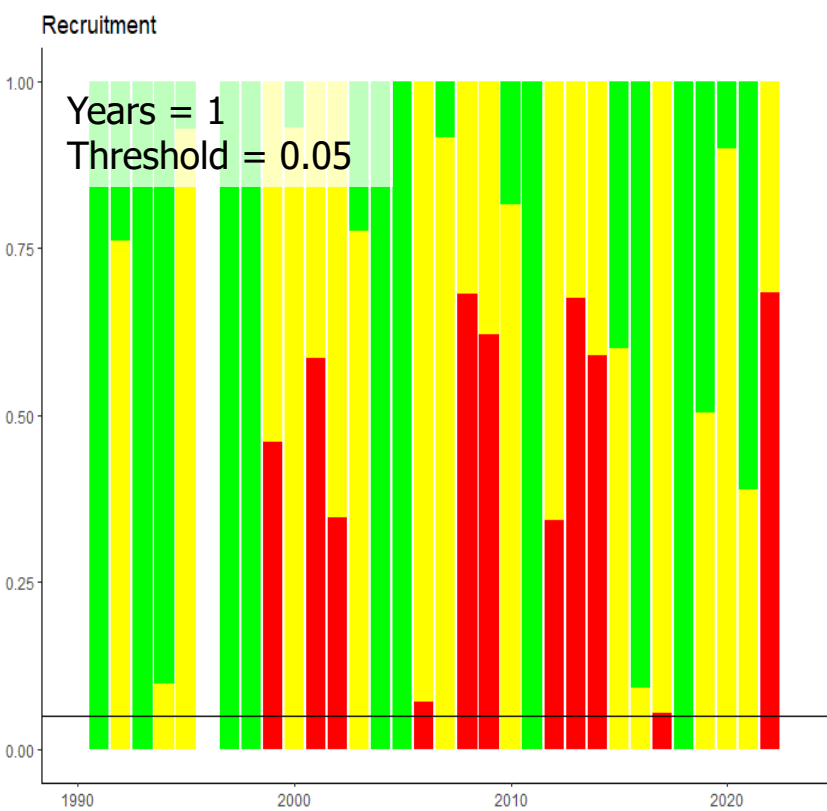
Northern Stock



Stock Synthesis



TLA – Annual Performance Metrics



Management Trigger Time Frame

- Moderate (yellow or red in all years)
- Elevated (red in all years)



TLA – Summary Table

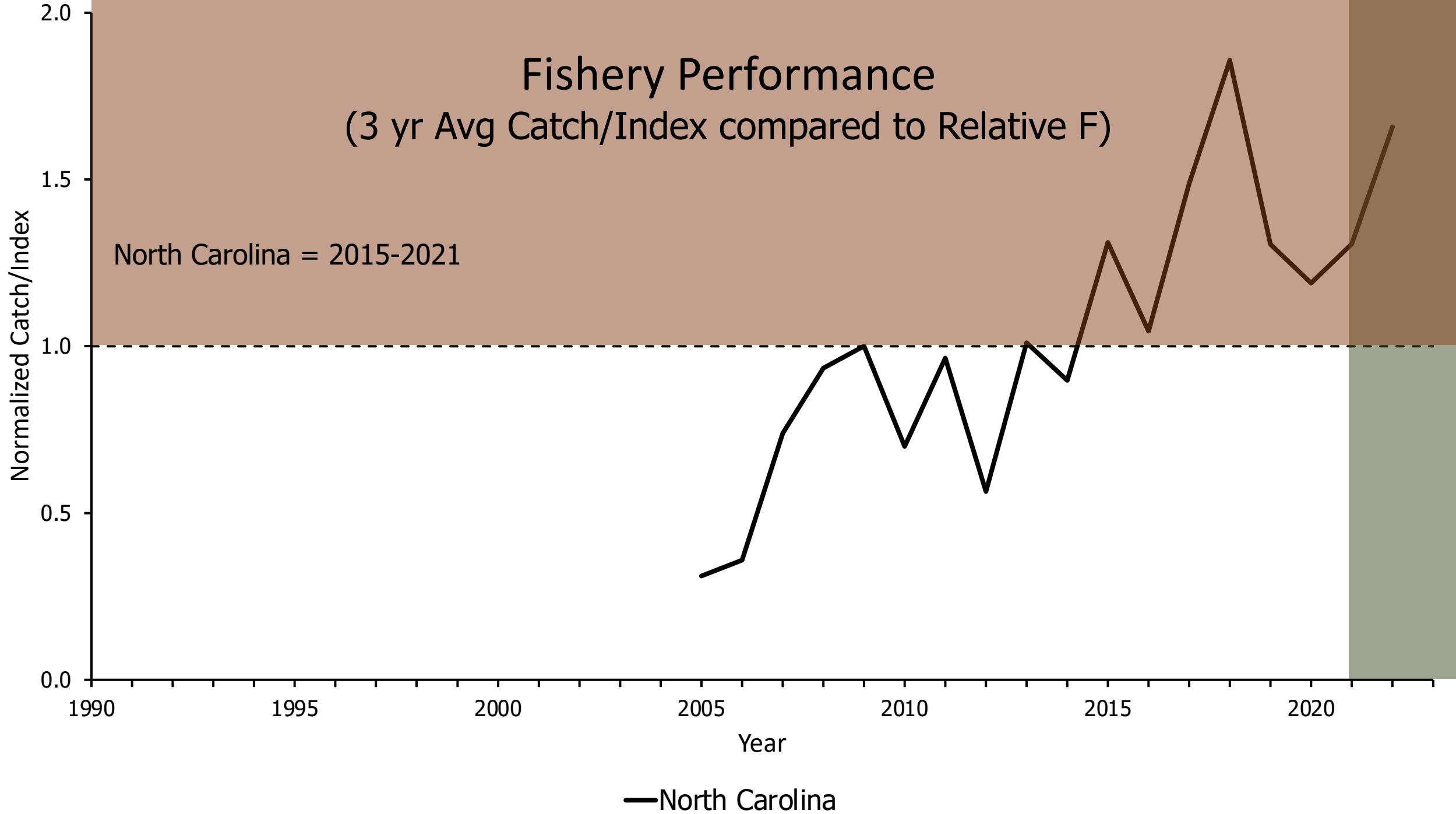
Year	Recruitment	Adult_Abundance	Fishery_Performance
2018	No Action	No Action	Moderate Action
2019	Moderate Action	No Action	Moderate Action
2020	Moderate Action	No Action	Moderate Action
2021	Moderate Action	No Action	Moderate Action

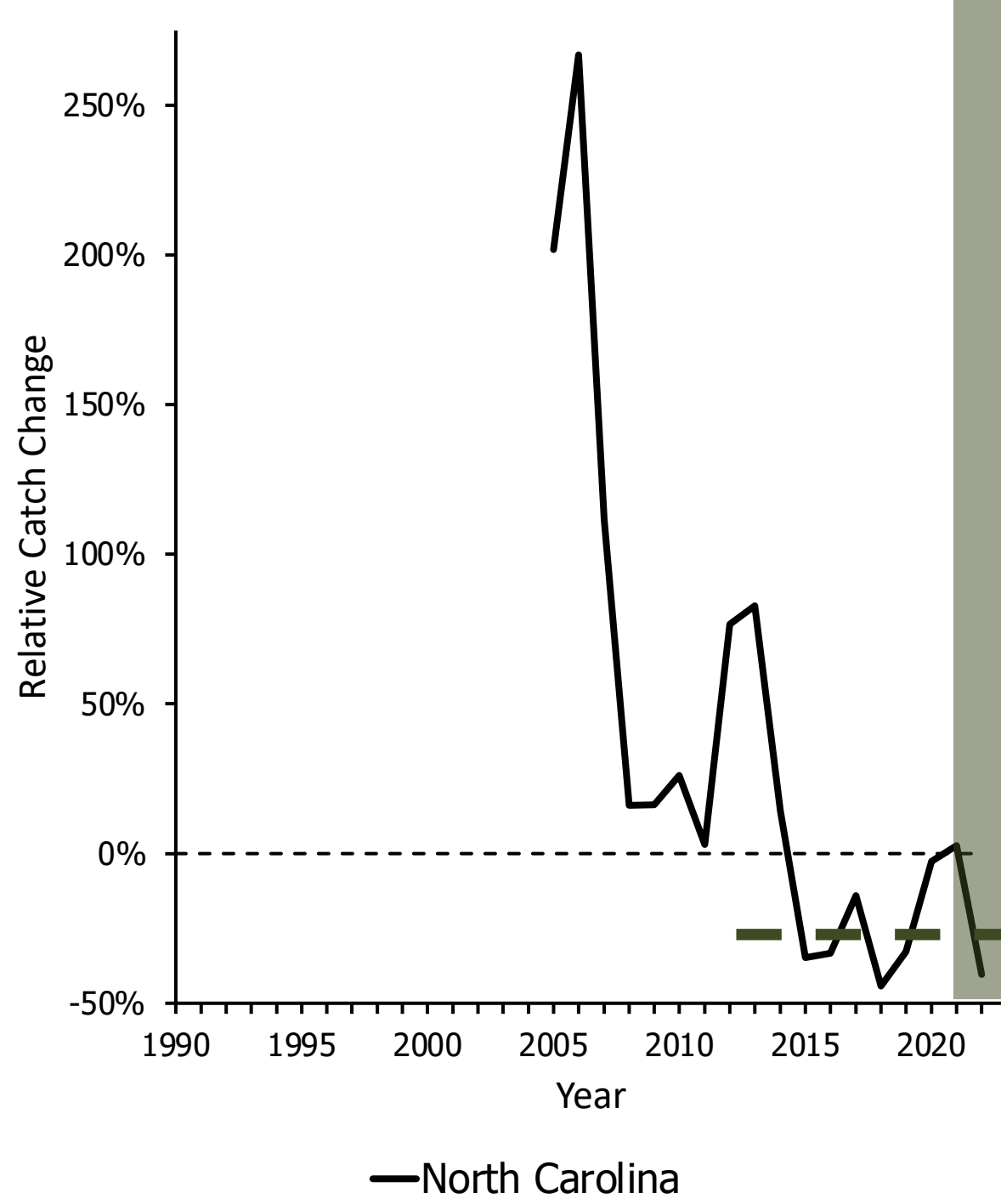
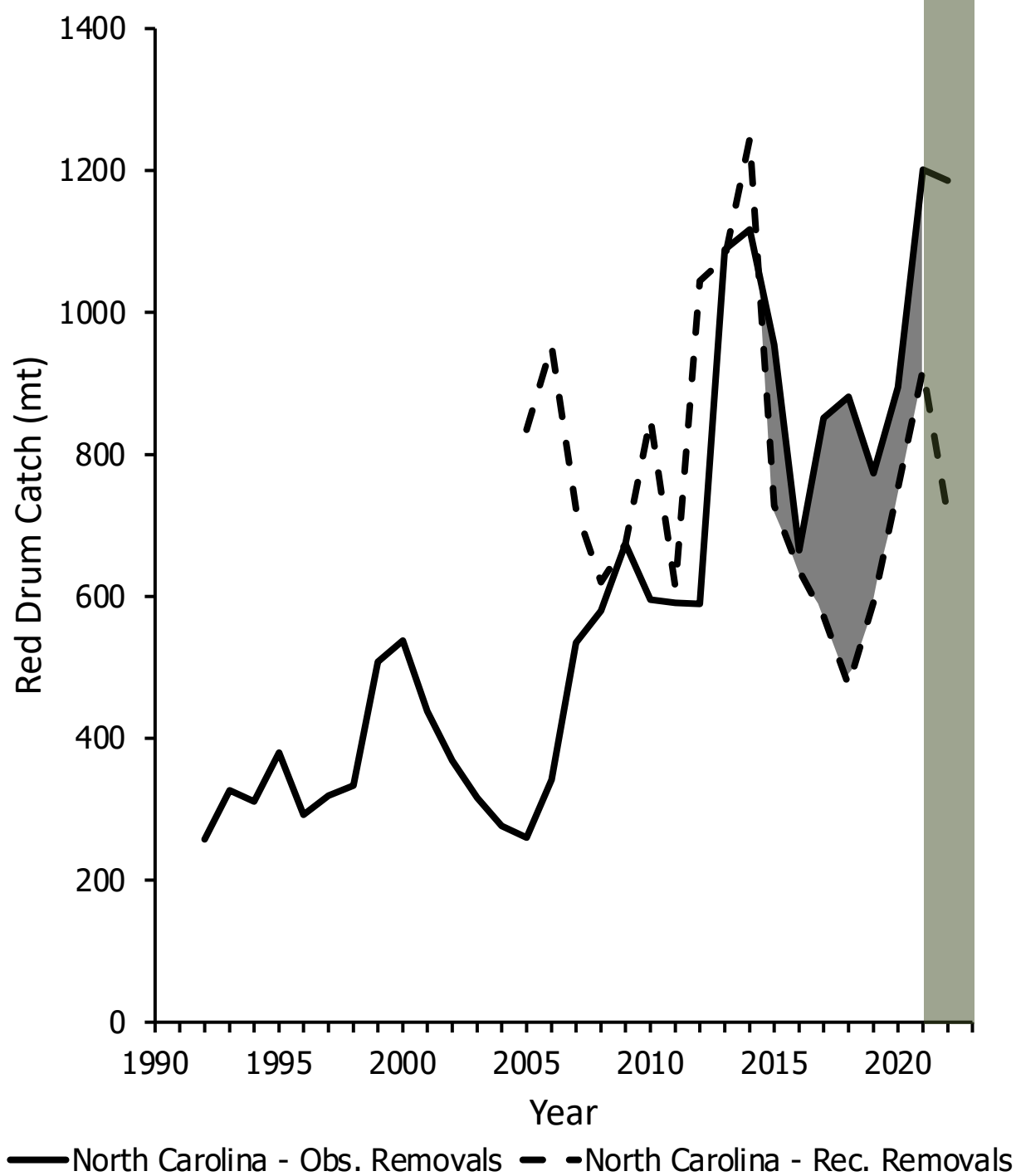


Fishery Performance

(3 yr Avg Catch/Index compared to Relative F)

North Carolina = 2015-2021





Northern Population Stock Status Determination



Stock Status Determination

Stock Synthesis Model

Use to inform trends in F , not for stock status determination



Stock Status Determination

Stock Synthesis Model

Use to inform trends in F , not for stock status determination

Traffic Light Analysis (complementary analysis)

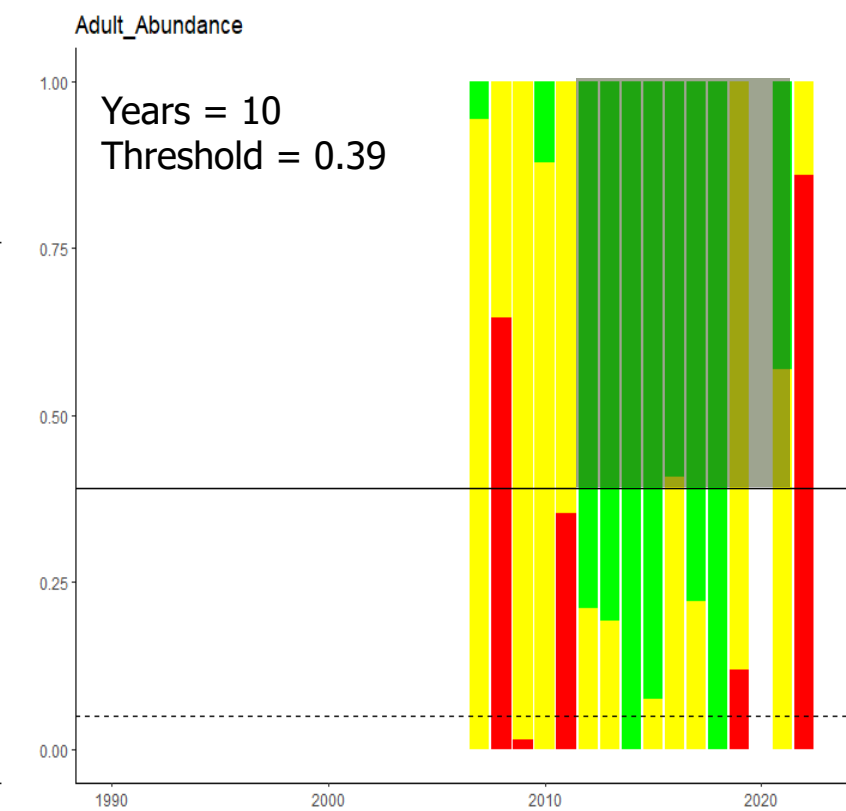
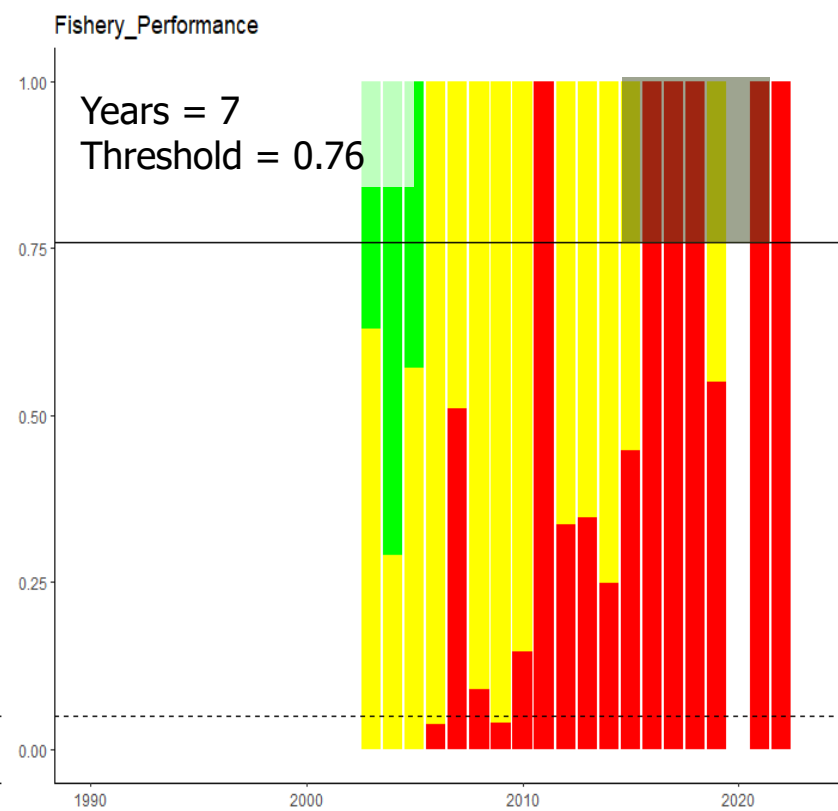
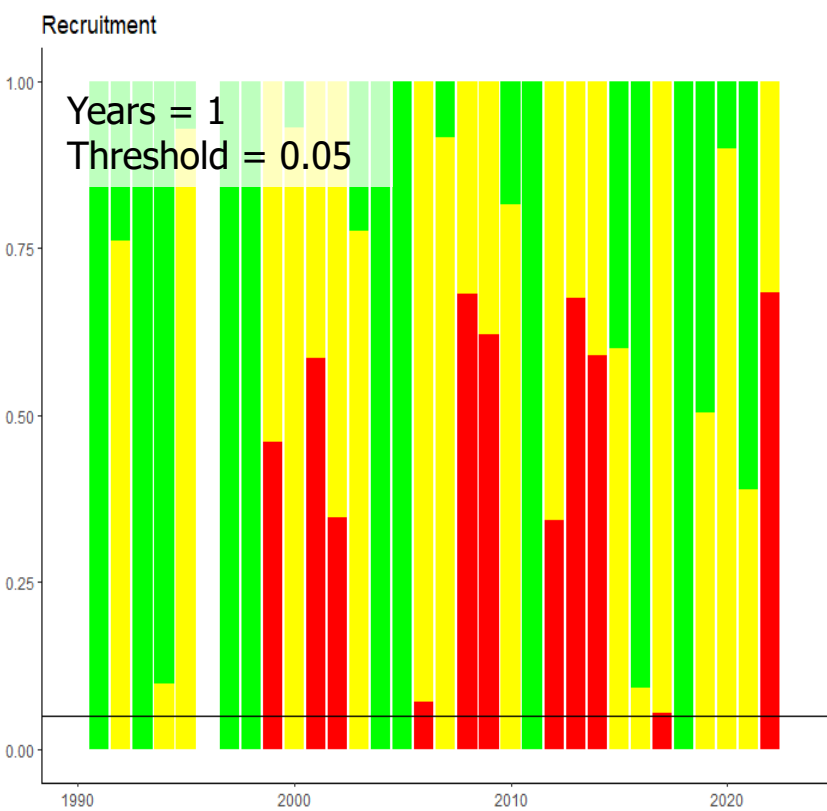
Not Overfishing – Fishery Performance **not** red in any of the past 3 years

Not Overfished – Adult abundance **not** red in any of the past 3 years

Note: none of the other scenarios based on TLA analysis identified to trigger management action were triggered



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Use to inform trends in F , not for stock status determination

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Skate Analysis (complementary analysis)

Extended period of non-sustainable catch (e.g., overfishing)

Relative catch change of ~23% needed since ~2015



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Relative catch change of ~23% needed since ~2015

All 3 analyses suggests recent increasing trends in F

Still data limited regarding status throughout the entire range; data limited north of NC leading to increased stock status uncertainty (trending increasing catch in VA)



Southern Stock



Stock Synthesis

Reference Points (using 3 yr. avg.)

Overfishing

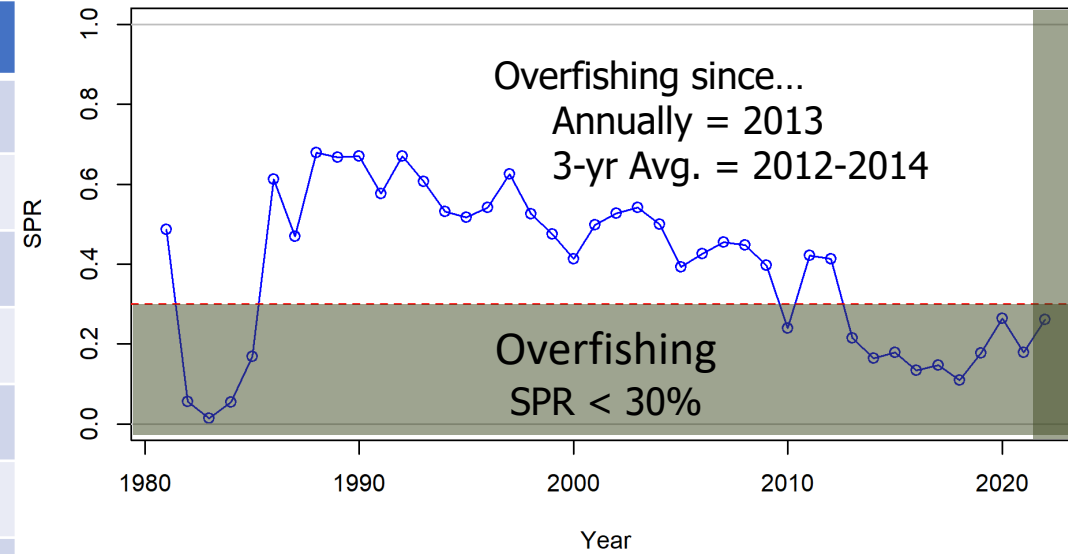
$< 30\% \text{ SPR or } (1 - \text{SPR}) > 70\%$

Overfished – previously not defined

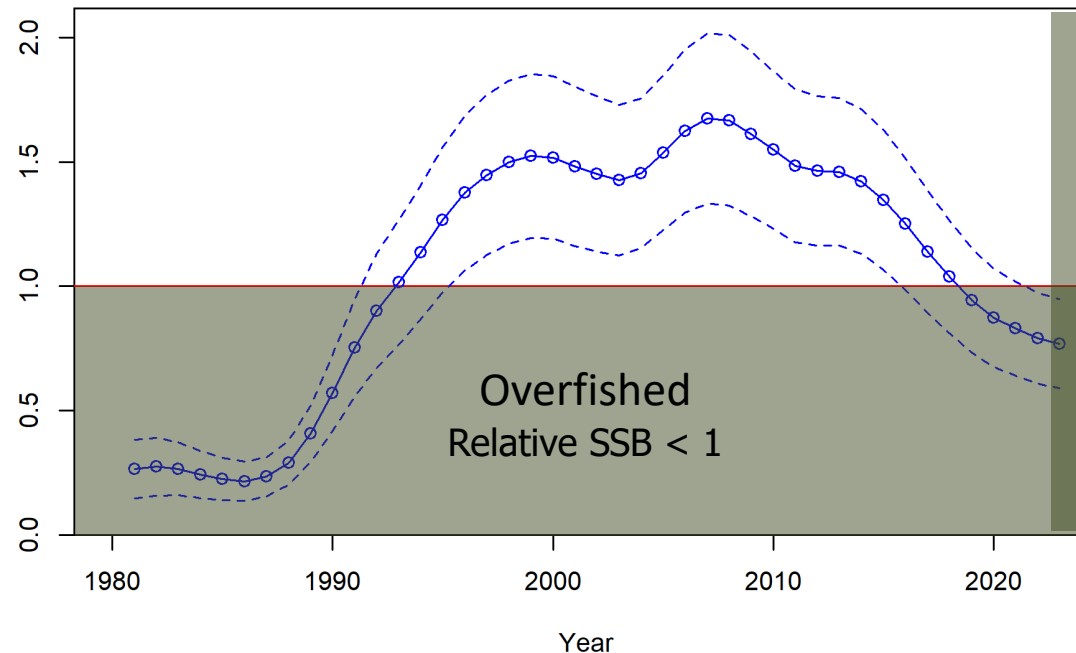
SSB associated w/ 30% SPR

Fishing Year(s)	Relative SSB
2017	1.139
2018	1.037
2019	0.942
2020	0.873
2021	0.830
2022	0.790
2017-2019	1.040
2018-2020	0.951
2019-2021	0.881

Fishing Year(s)	SPR
2017	0.148
2018	0.109
2019	0.178
2020	0.264
2021	0.179
2022	0.262
2017-2019	0.145
2018-2020	0.184
2019-2021	0.207



Relative spawning biomass: $B/(30\% \times \text{Virgin_Biomass})$



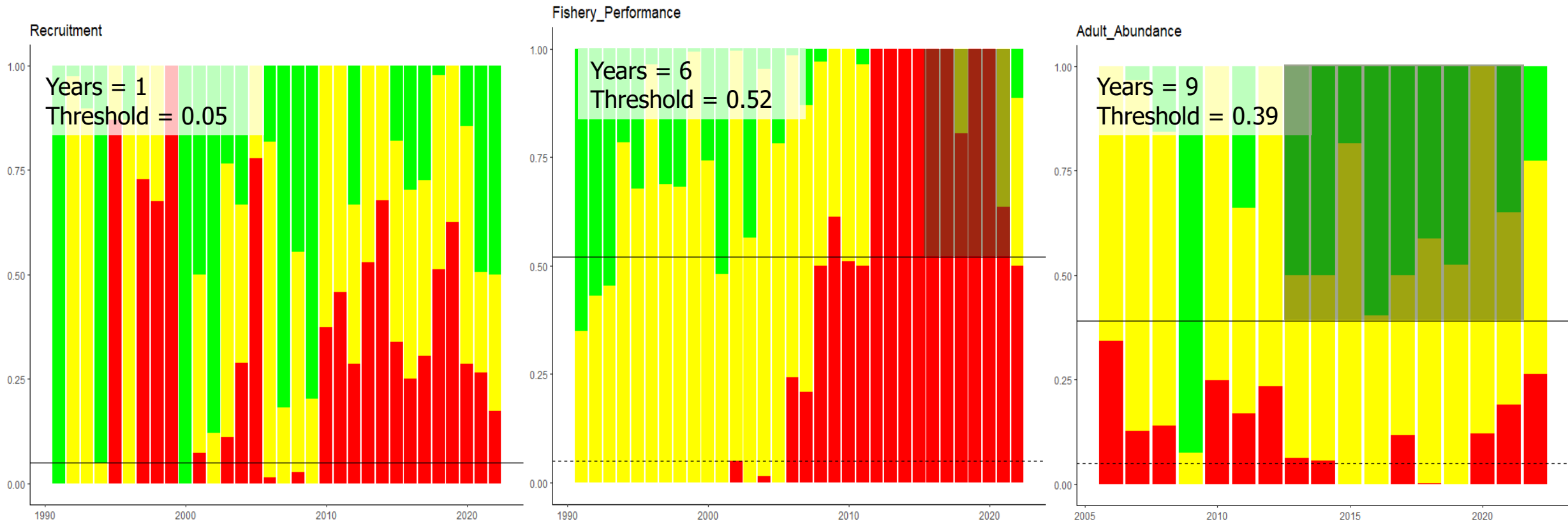
Overfished since...

Annually = 2019

3-yr Avg. = 2018-2020



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Overfishing

Fishery performance red for at least 1 of the last 3 years



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Adult Abundance **not** red for at least 1 of the last 3 years



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Not Overfished

Adult Abundance **not** red for at least 1 of the last 3 years

2 additional TLA management triggers using adult abundance triggered

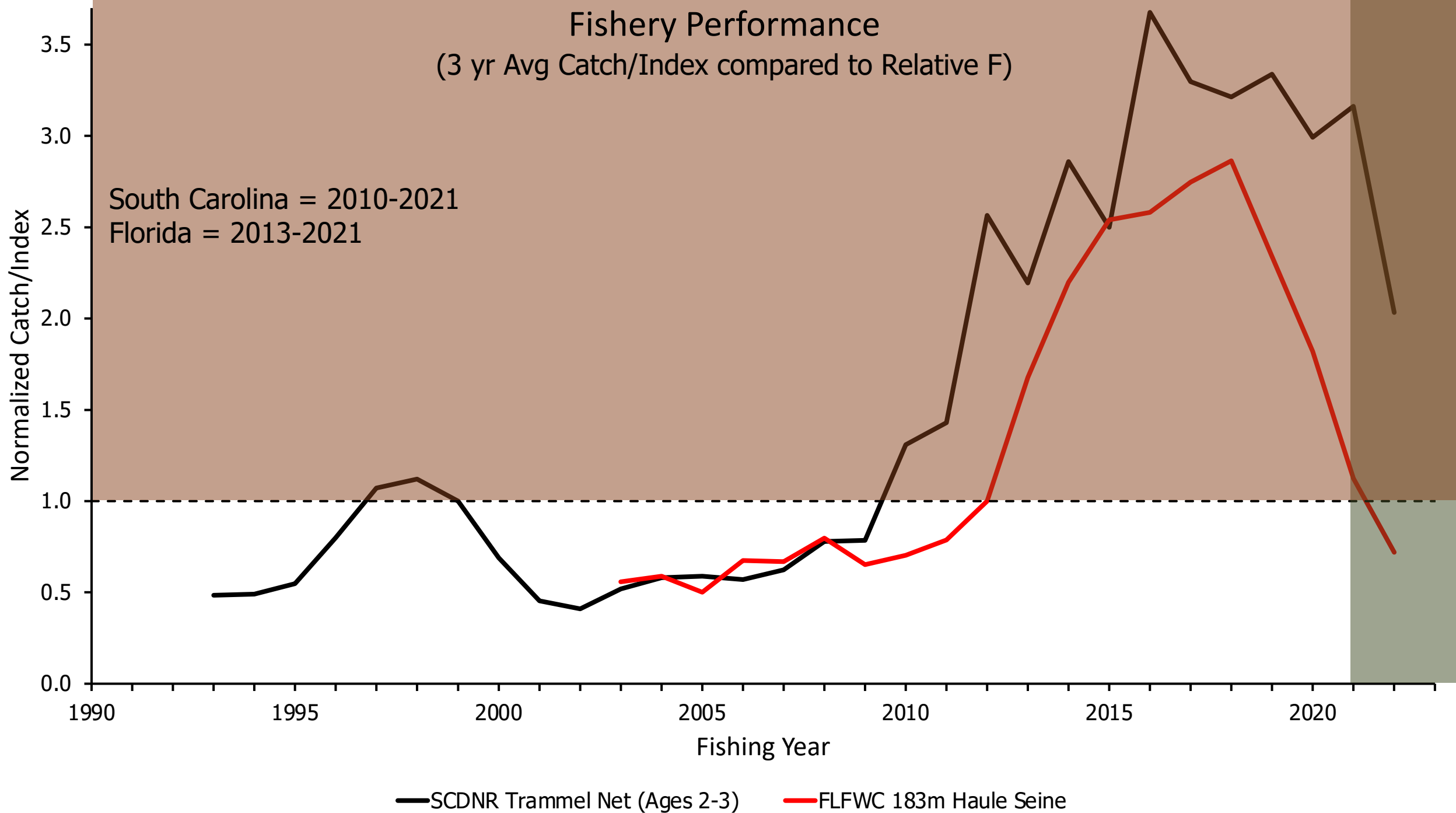
Both fishery performance & adult abundance in any of the past three years are yellow (or red)

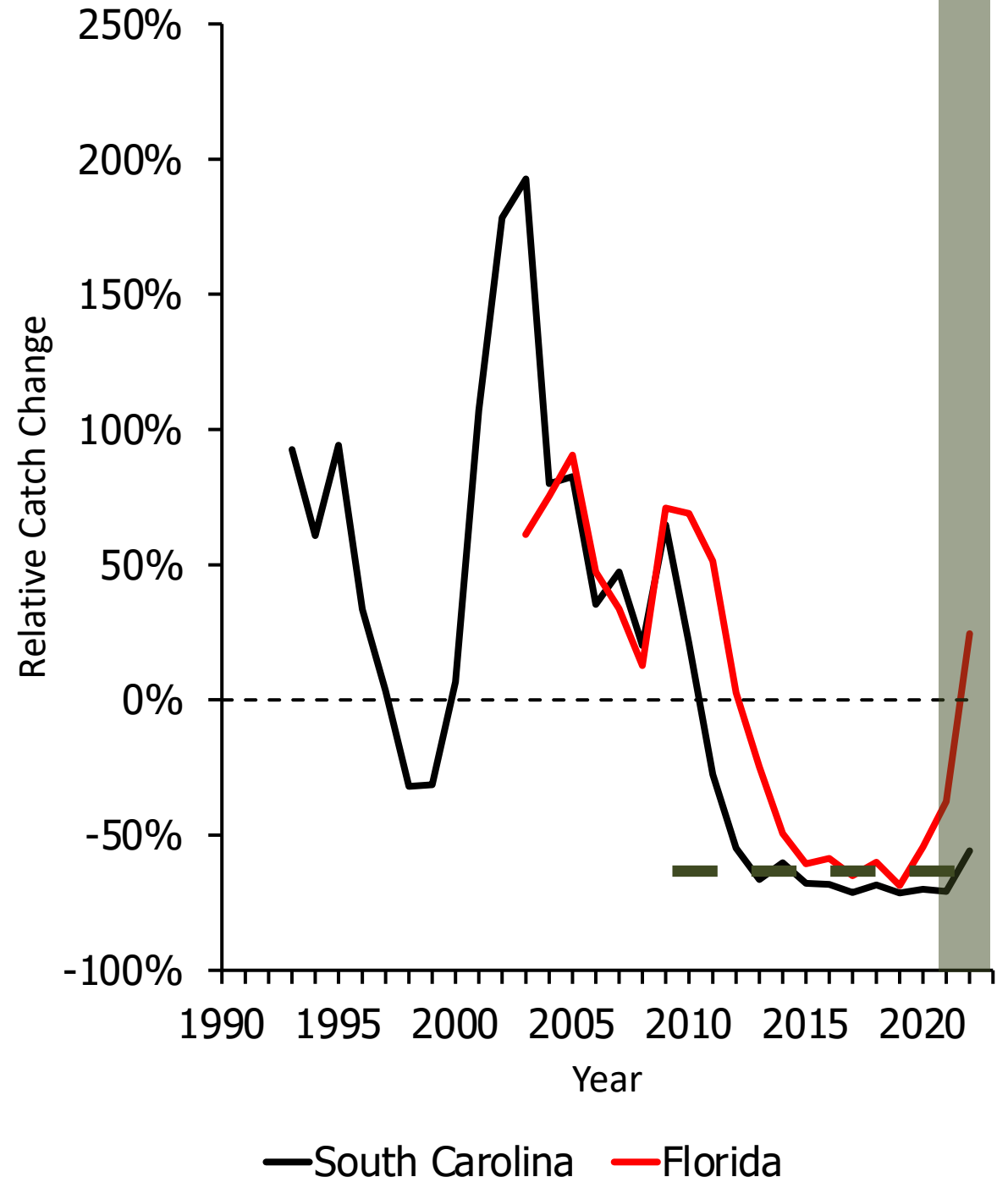
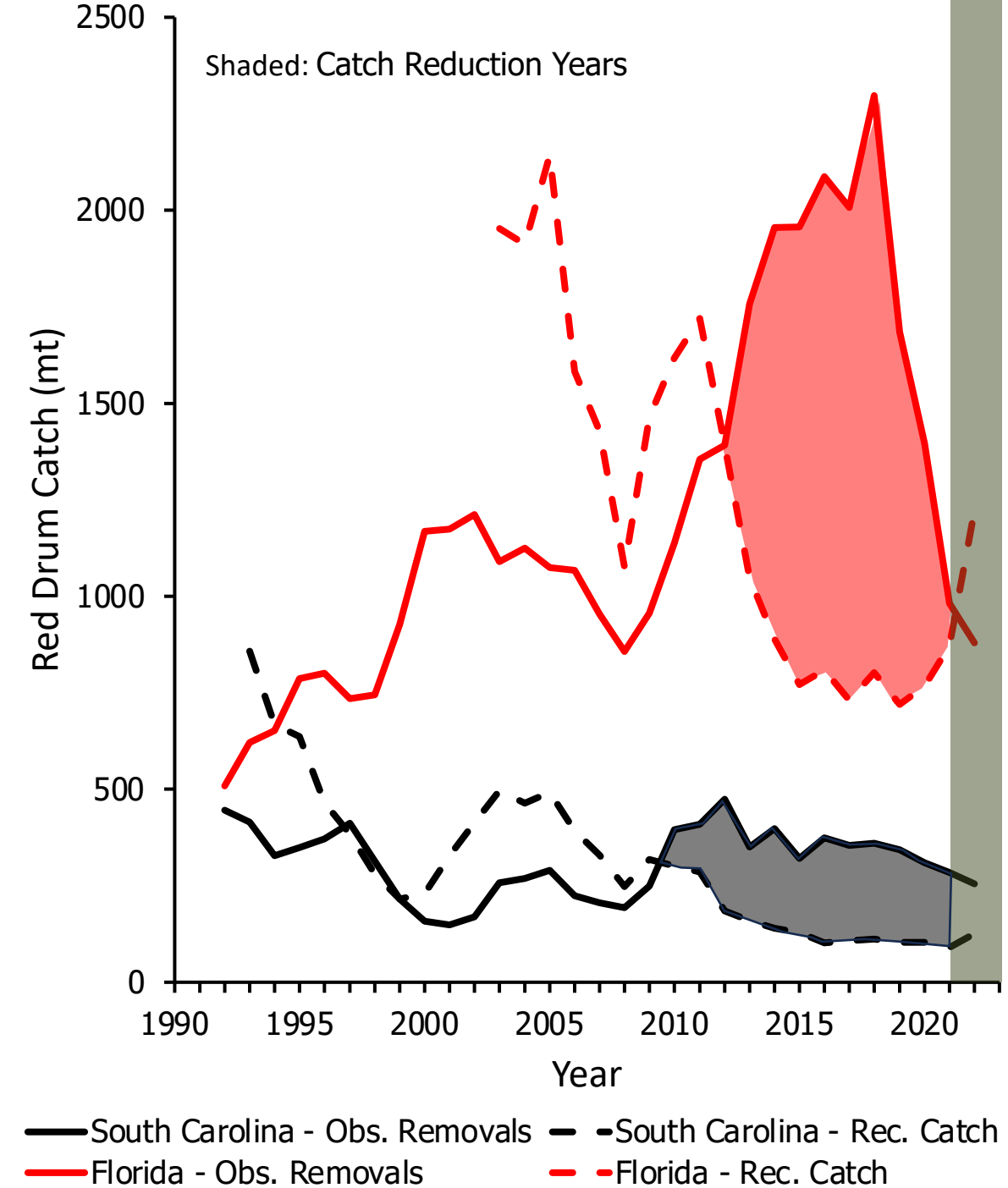
Sign of increasing catch and/or decreasing sub-adult abundance

Recruitment red for 5 consecutive years & adult abundance yellow in any of the past 3 years

Sign of consistent below average recruitment increasing change of future declines in adult abundance



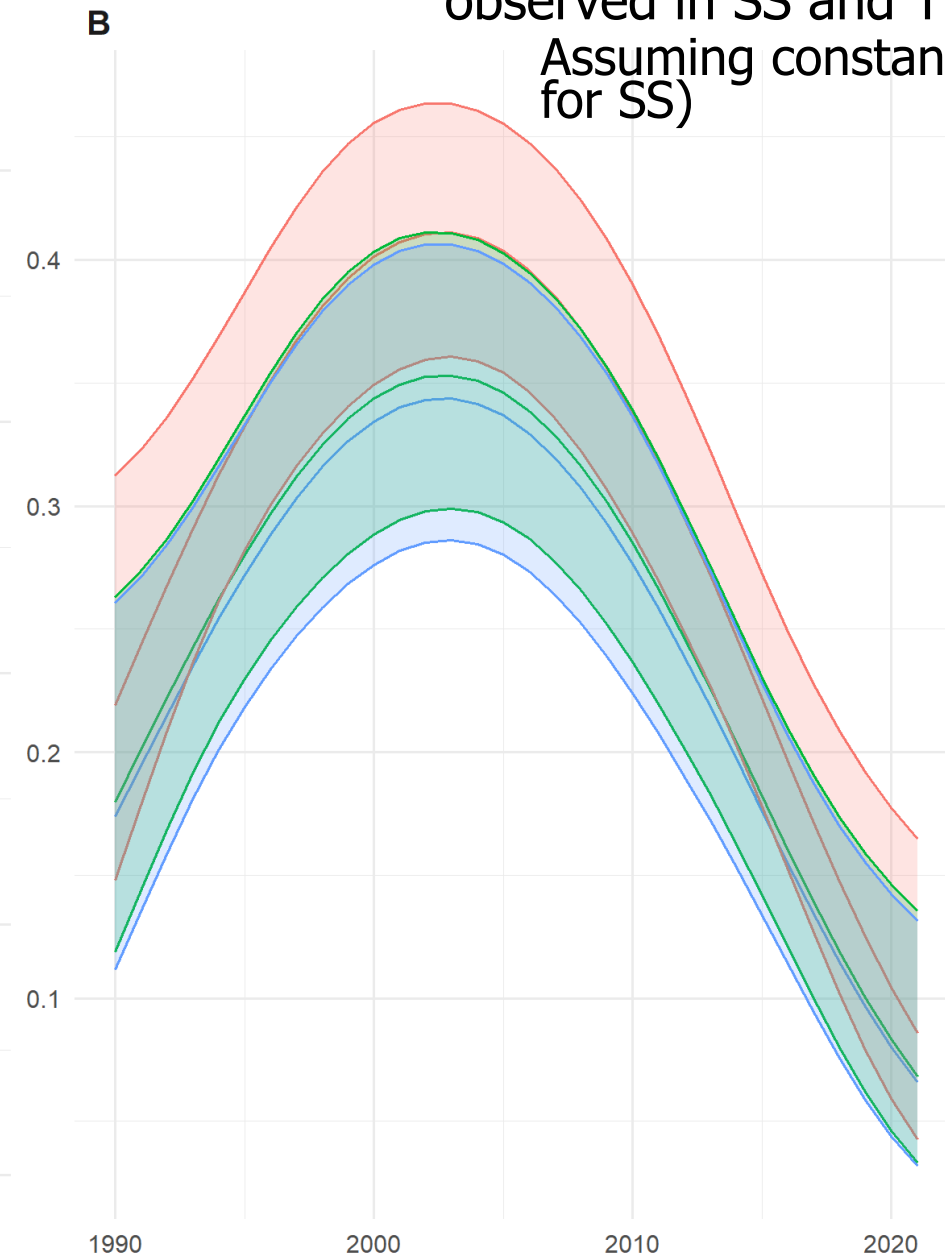
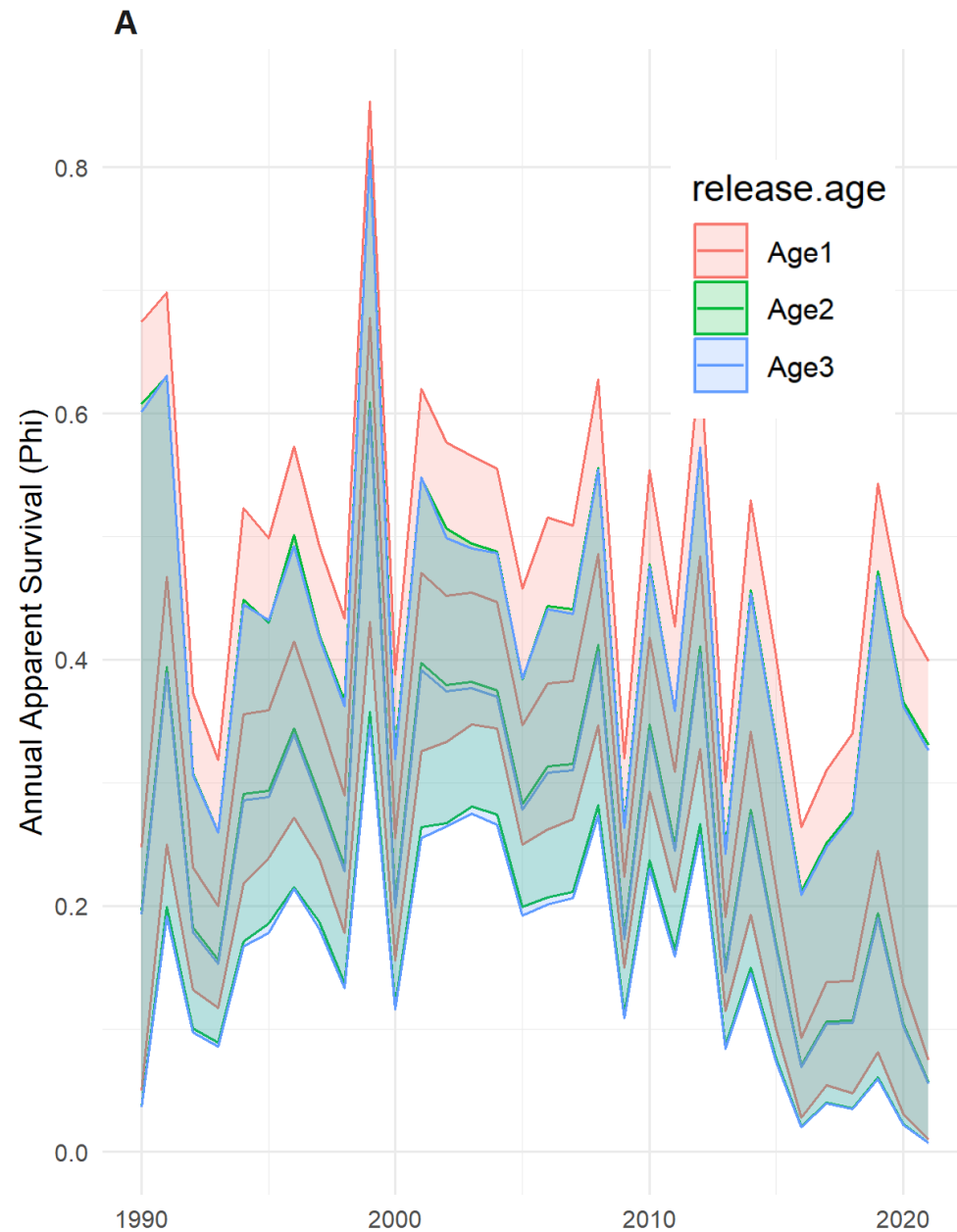




Cormack-Jolly-Seber Model

Age1 Age2 Age3

Declining Apparent Survival =
Increasing F (same trend as
observed in SS and TLA analyses)
Assuming constant M (assumed
for SS)



Southern Population Stock Status Summary



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Stock Synthesis Base Model

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Traffic Light Analysis (complementary analysis)

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Stock experiencing increasing catch and/or decreasing sub-adult abundance

Leading to declines in adult abundance

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Relative catch change of on the order of 48% (FL) and 67% (SC) needed since ~2012



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Overfishing – Fi

Not Overfished

Both fishery

Stock ex

Lea

Recruitment is red for 5 consecutive years and adult abundance is yellow in any of the past 3 years

Below average recruitment representing concern for the future of the adult abundance

Note: Same stock status when using 2022 data

3-year avg SSB decreases

More overfished

3-year avg SPR increases (still below threshold)

Driven by strong year class in terminal year

tion were triggered

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