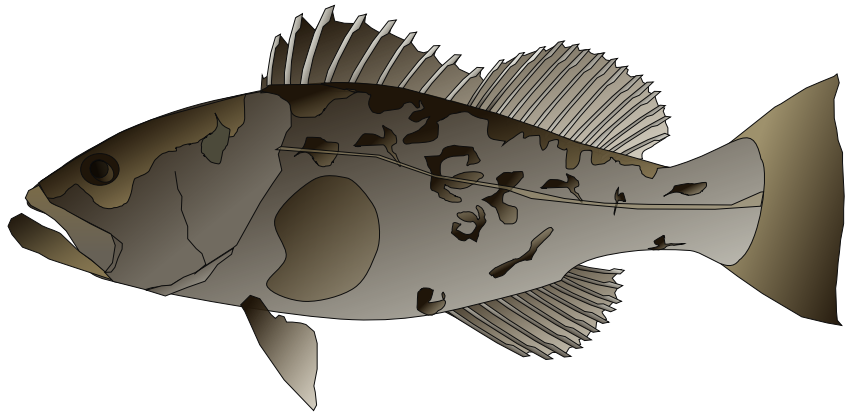
Leveraging statistical models to improve pre-season forecasting and in-season management of a recreational fishery



A. Challen Hyman, Chloe Ramsay, Tiffanie A. Cross, Beverly Sauls, and Thomas K. Frazer

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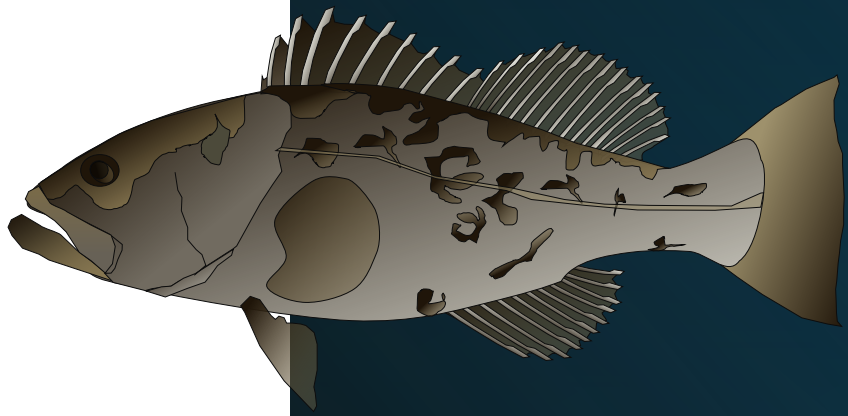
- Use of temporal harvest restrictions to reduce fishing pressure is a primary management tool



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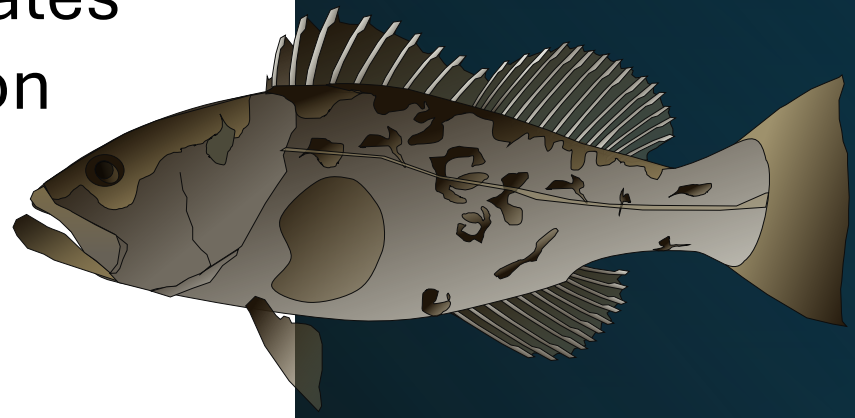

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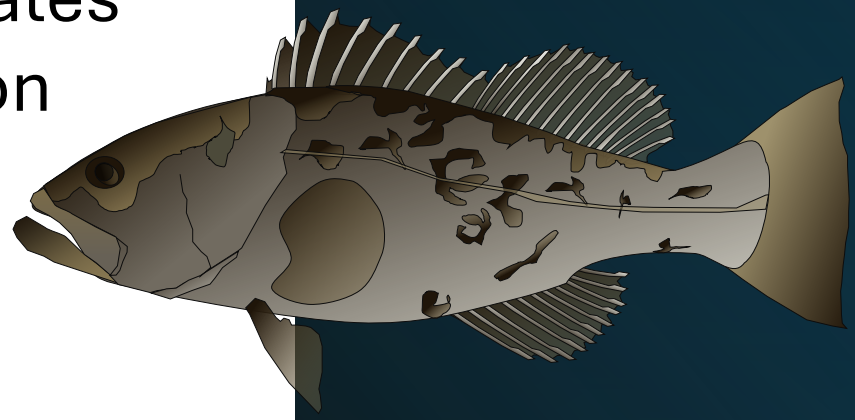

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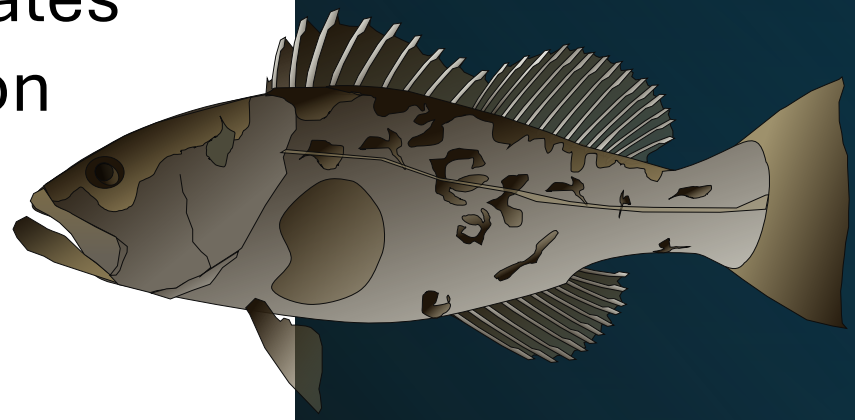
  - Current approaches rely on past harvest averages for projections
  - Problematic when past conditions are not representative of present



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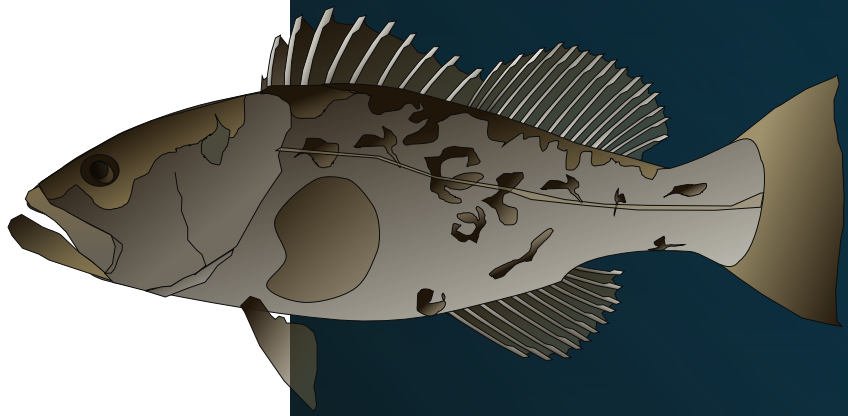
- Particularly problematic when seasons dramatically compress



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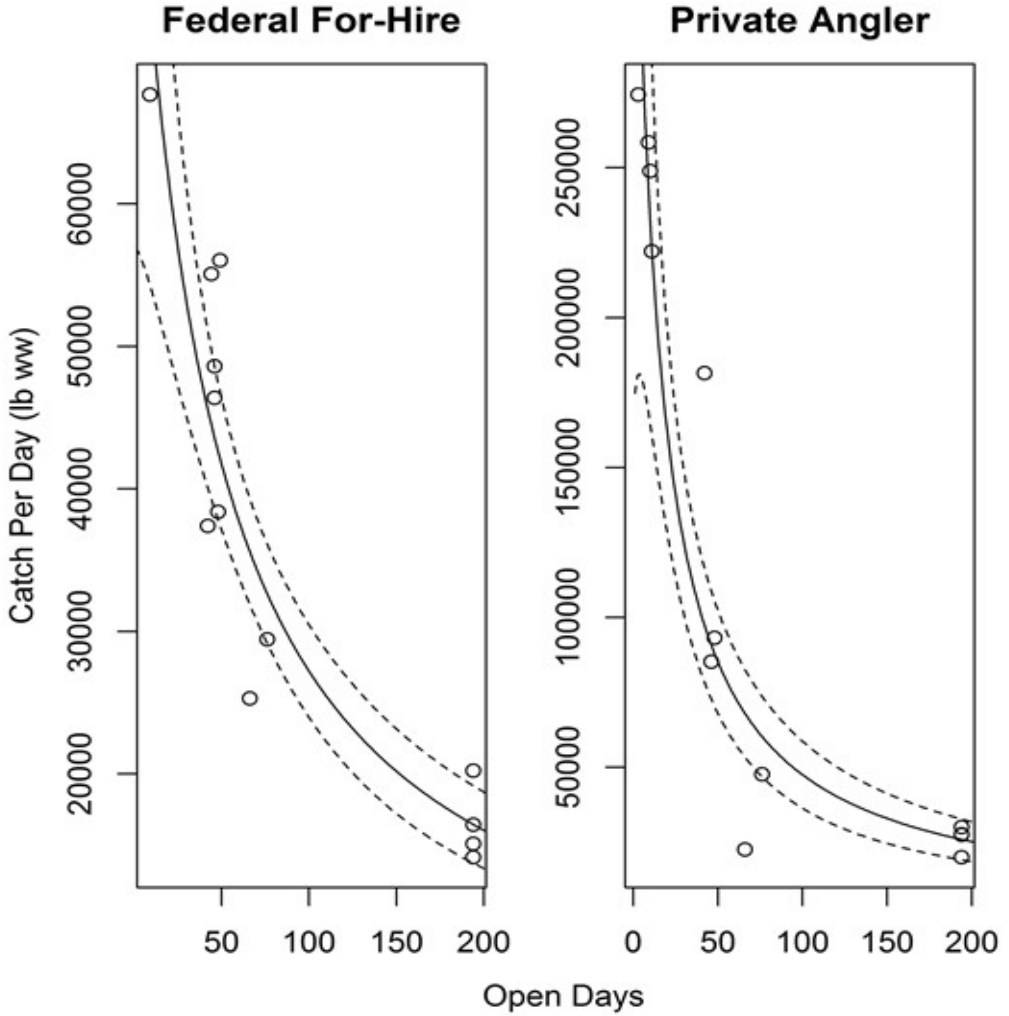
- Particularly problematic when seasons dramatically compress

- For highly targeted fisheries, anglers will alter fishing practices to concentrate effort within the smaller fishing window



Farmer et al., 2020

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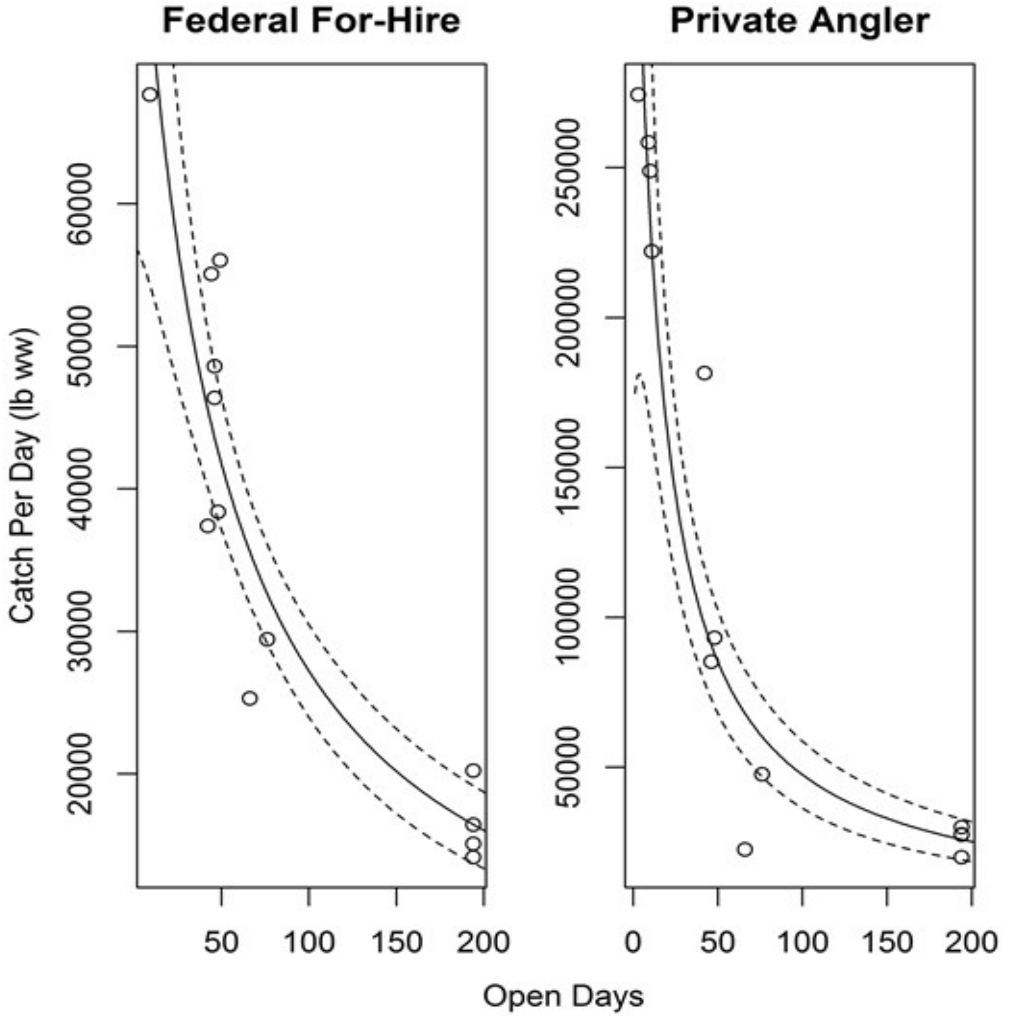
- Particularly problematic when seasons dramatically compress
- For highly targeted fisheries, anglers will alter fishing practices to concentrate effort within the smaller fishing window
- Projections based on years with longer seasons will underestimate harvest rates



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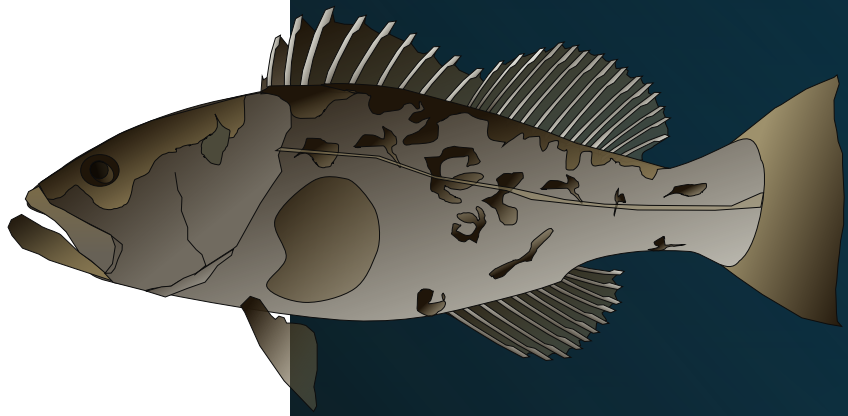
- Statistical models of fishing practices may offer a more accurate solution



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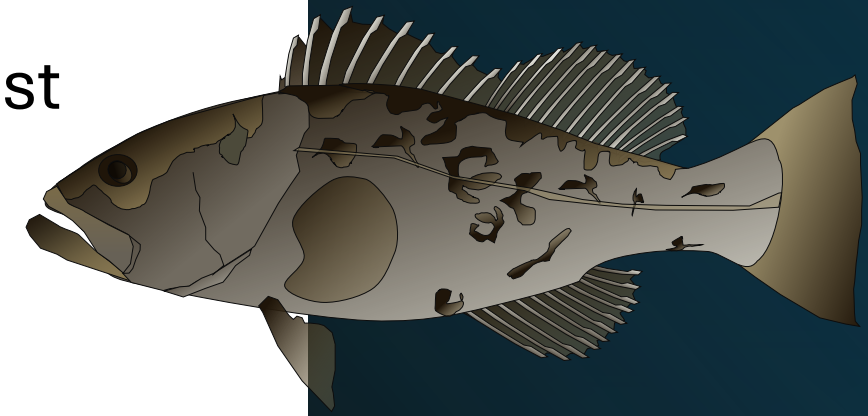

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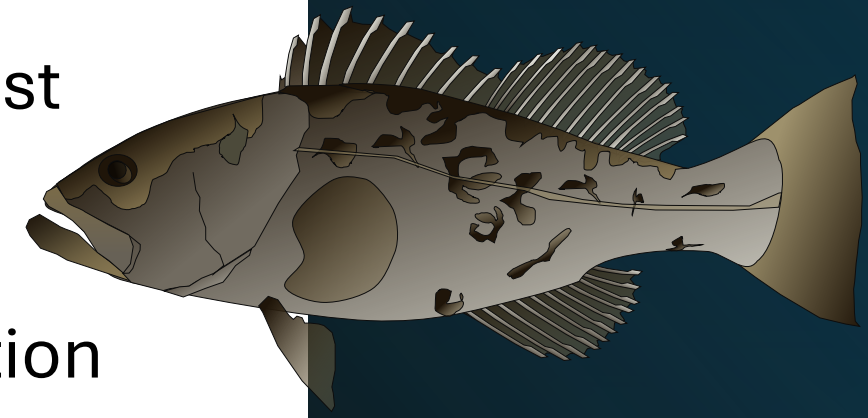

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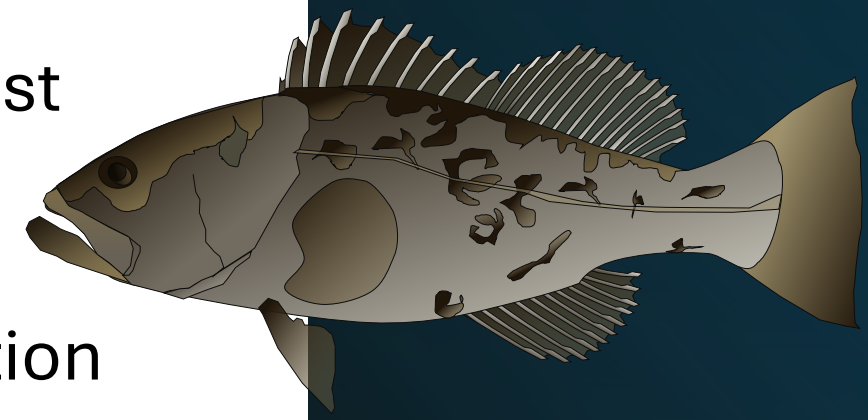
- Trained and applied statistical model to SRFS and MRIP gag harvest data



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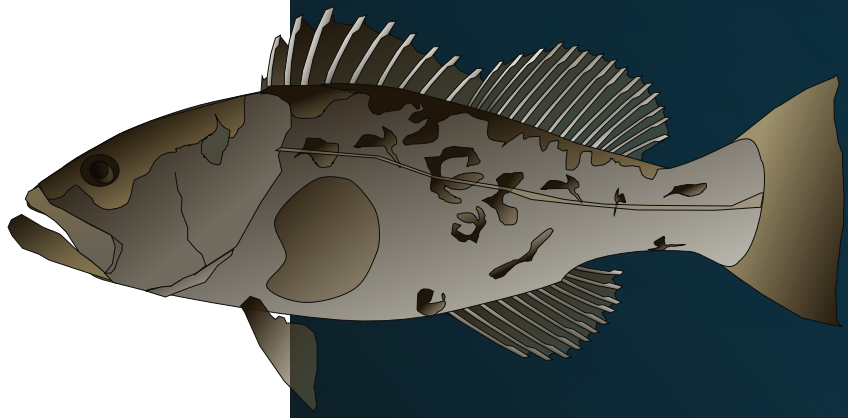
- Created a hurdle-gamma model to forecast preseason and intra-season harvest rates



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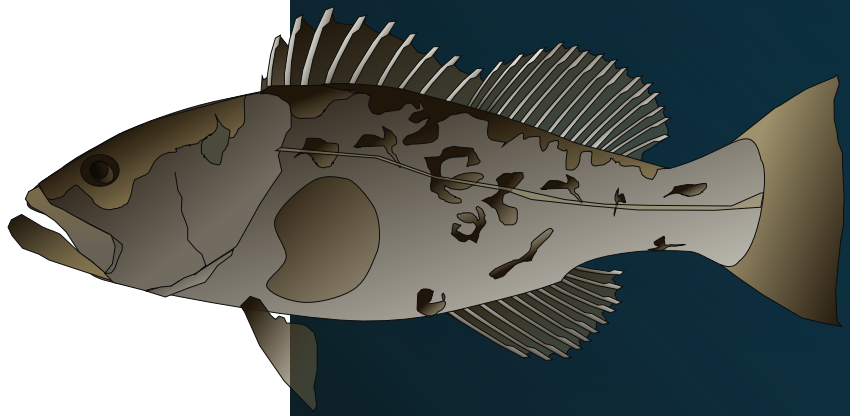
$$HG(y \mid \alpha, \phi, \theta) = \begin{cases} \theta, & y = 0 \\ (1-\theta)\text{Gamma}(y \mid \alpha, \phi), & y > 0 \end{cases}$$



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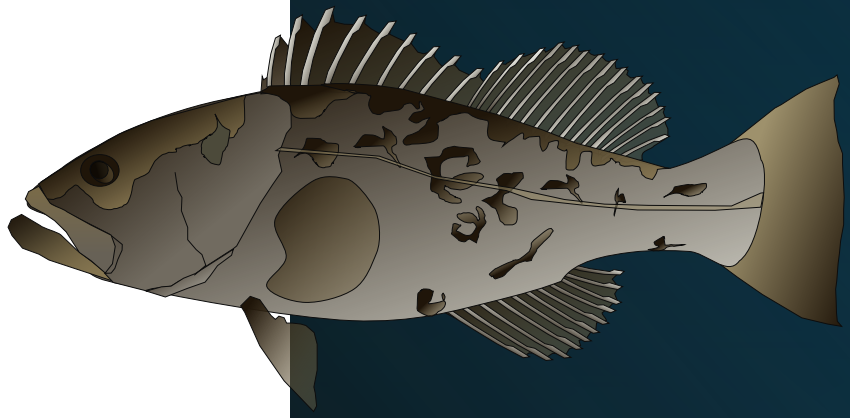
  - Pounds harvested divided by days open



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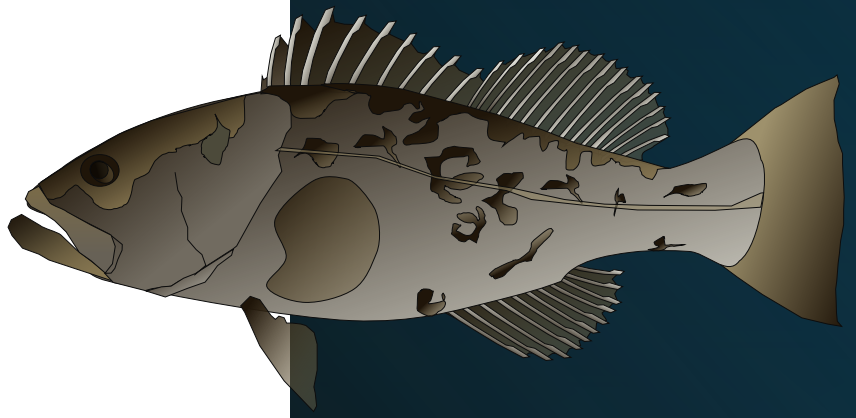
- Response variable was the monthly harvest rate
  - Pounds harvested divided by days open
- **Mean harvest rate** was a function of:
  - Season duration and type
  - Past harvest average
  - Harmonic terms
  - Year
  - Red snapper season (percent of month open)



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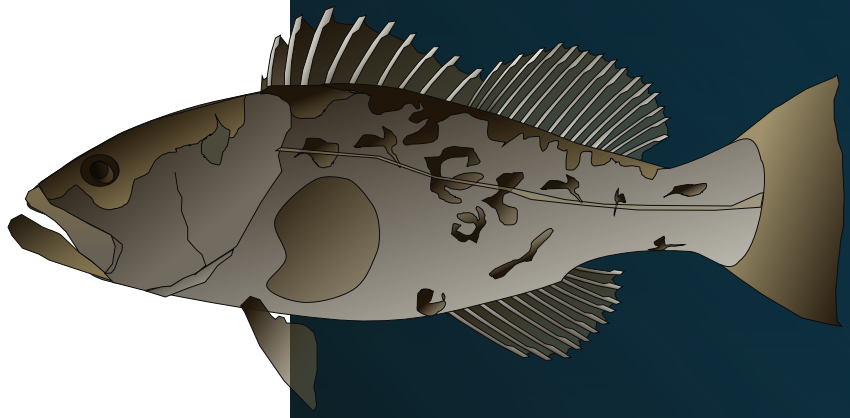
- **Hurdle** was a function of whether any recreational gag season was open (federal or state)



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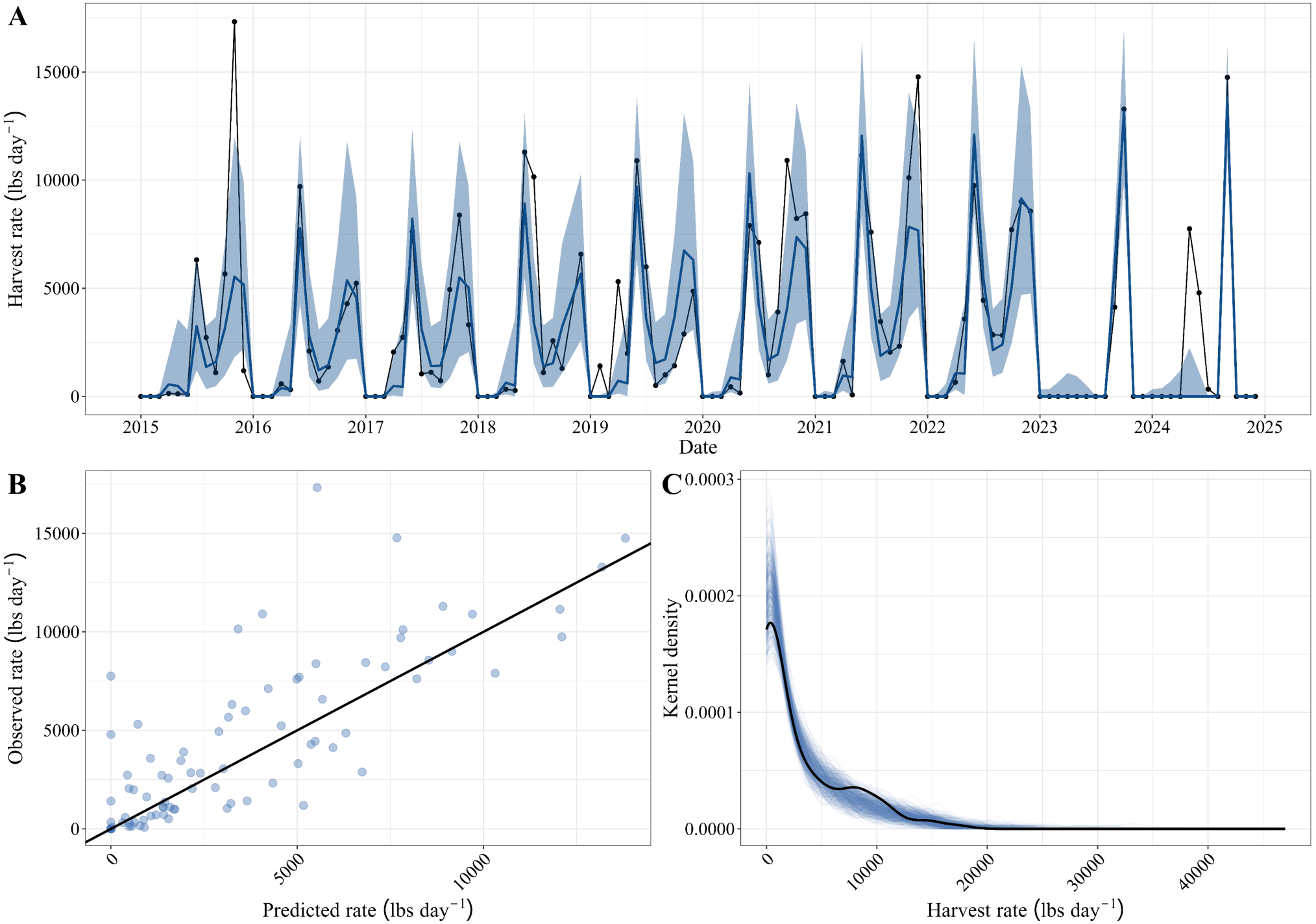
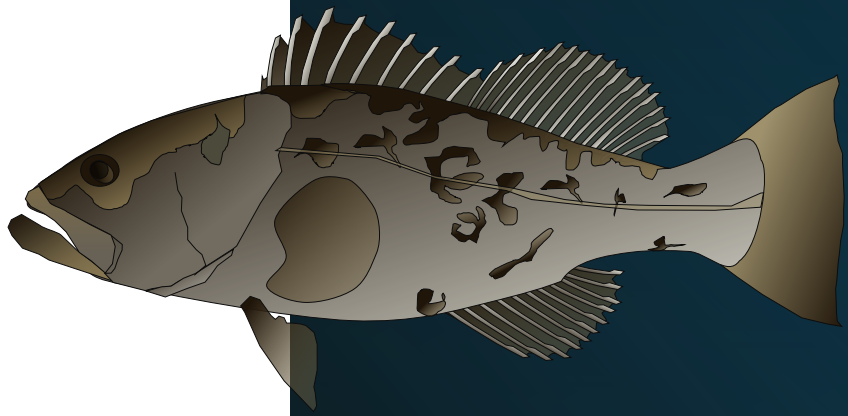

A
Harvest rate (lbs day^{-1})
15000
10000
5000
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Date
B
Observed rate (lbs day^{-1})
15000
10000
5000
0
0
5000
10000
Predicted rate (lbs day^{-1})
C
Kernel density
0.0003
0.0002
0.0001
0.0000
0
10000
20000
30000
40000
Harvest rate (lbs day^{-1})

Does it work better?



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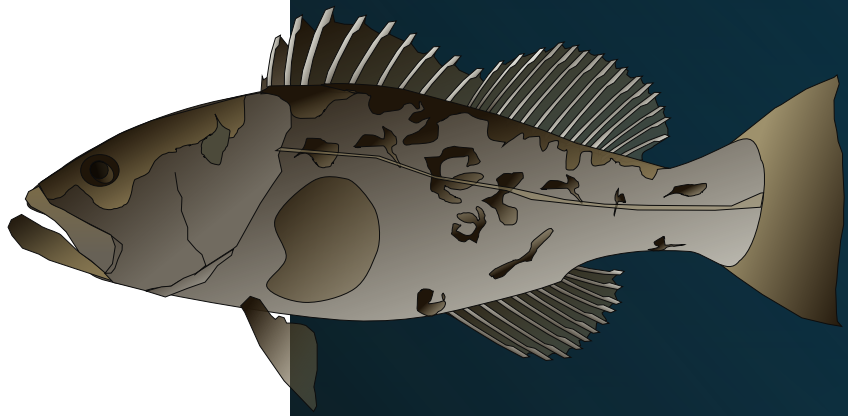
Does it work better?

- Compared predictions to current methods
  - Uses historical average harvest rate



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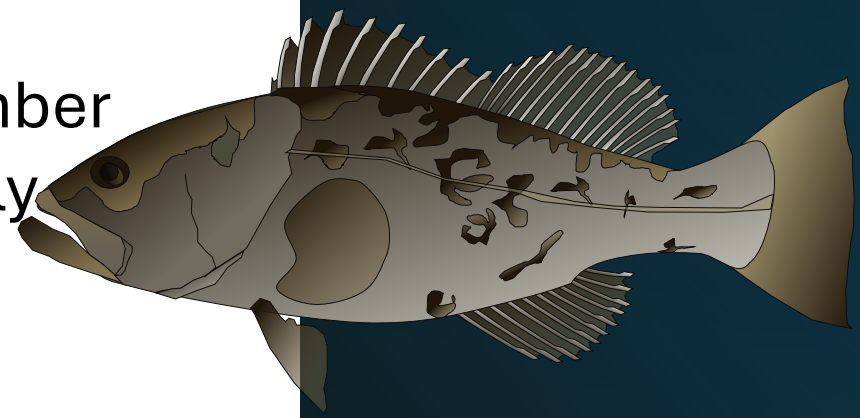

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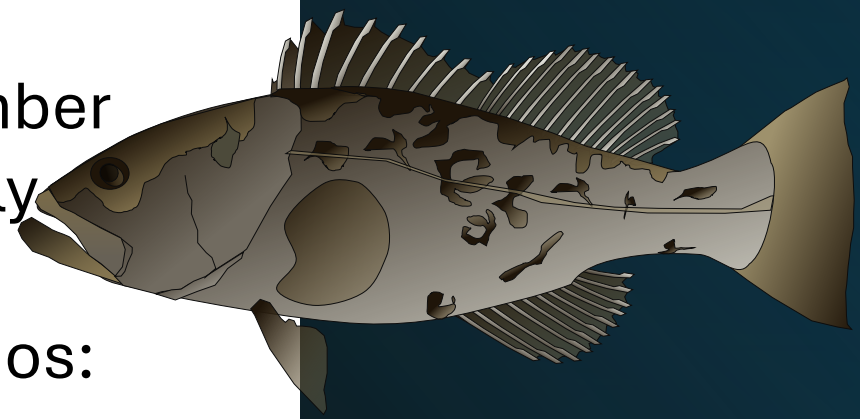
- Estimates compared under three scenarios:
  1. Full dataset
  2. Datasets with individual years withheld
  3. Datasets with individual months withheld



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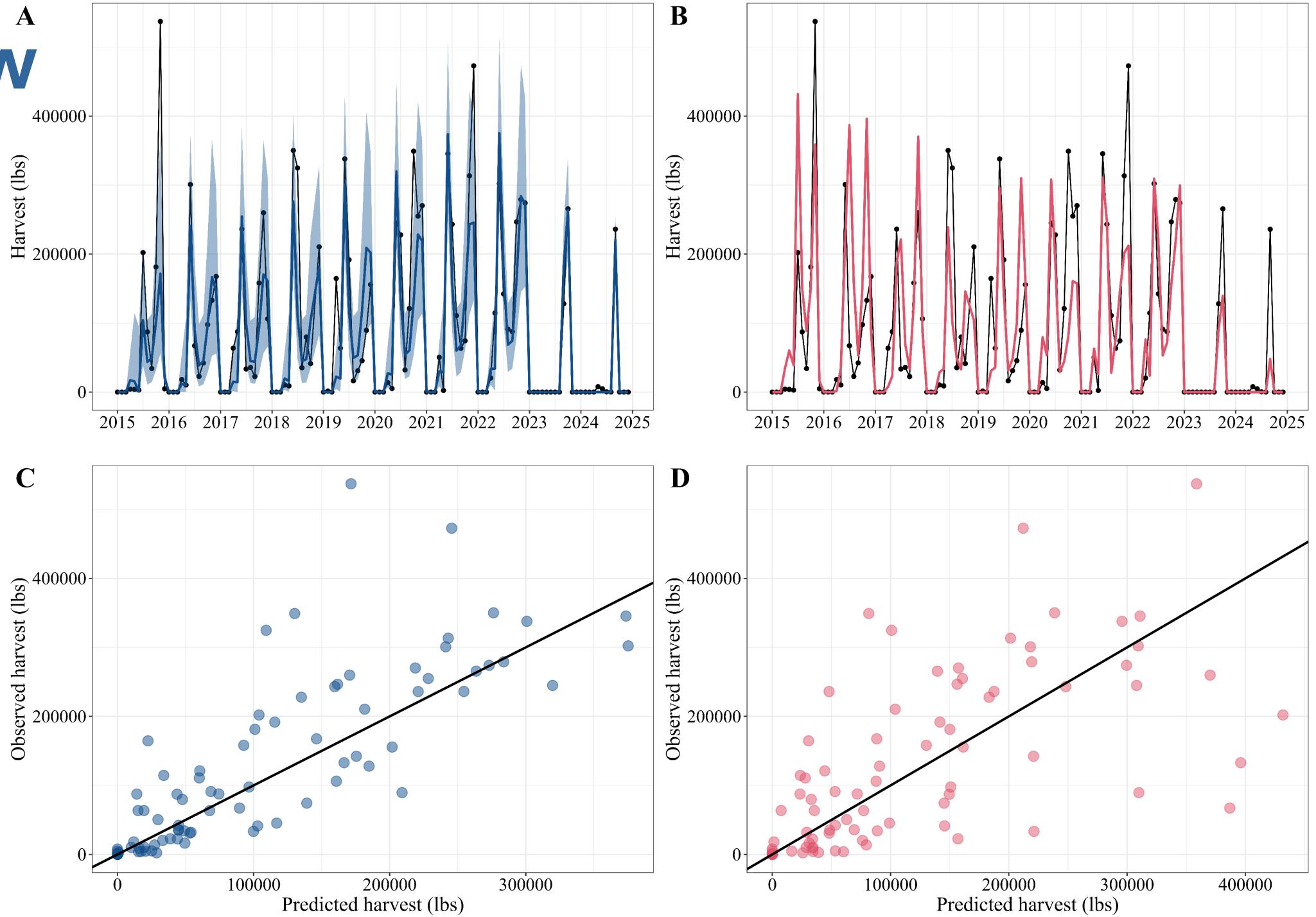
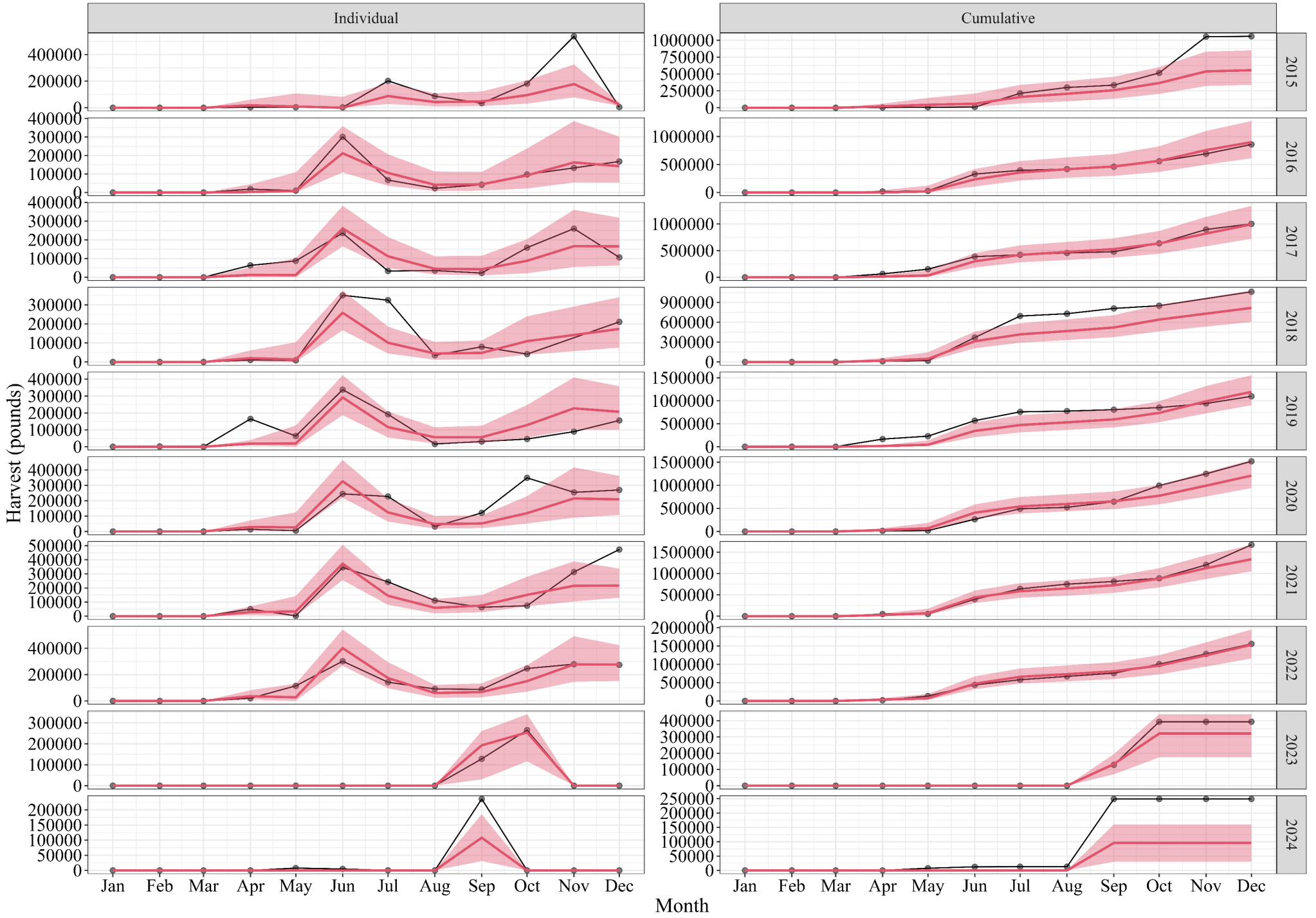
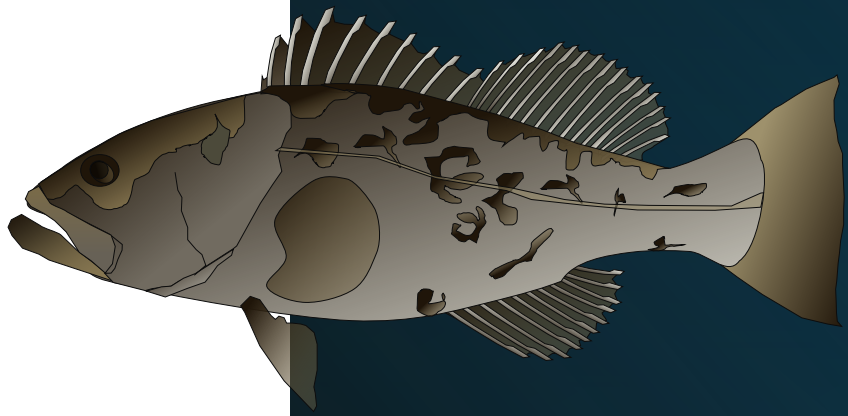
New

Old


A
B
C
D
Harvest (lbs)
Observed harvest (lbs)
Predicted harvest (lbs)
0
200000
400000
100000
300000
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025


Individual
Cumulative
Harvest (pounds)
Month
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Does it work better?



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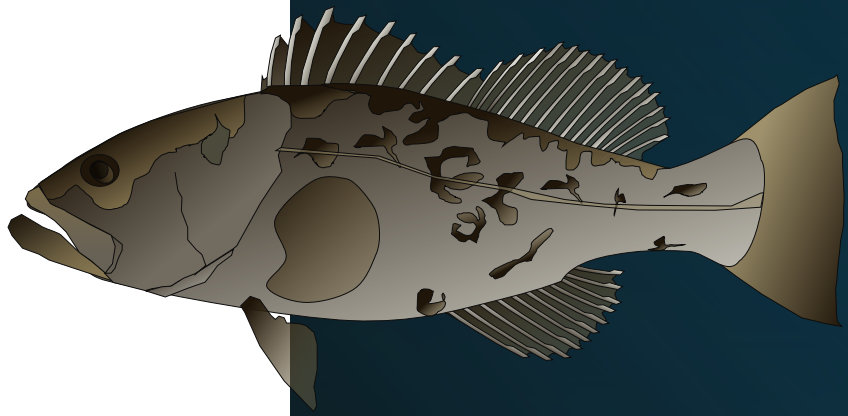
Does it work better?

- 25% lower RMSE when fit to full dataset



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Does it work better?

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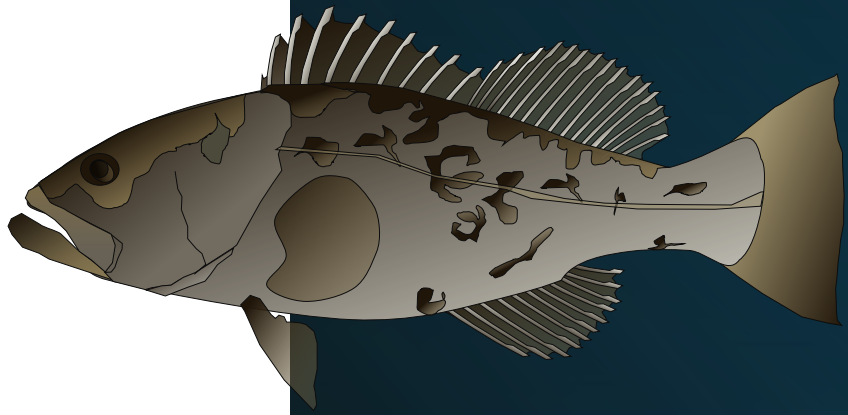
- 32% lower when predicting next year



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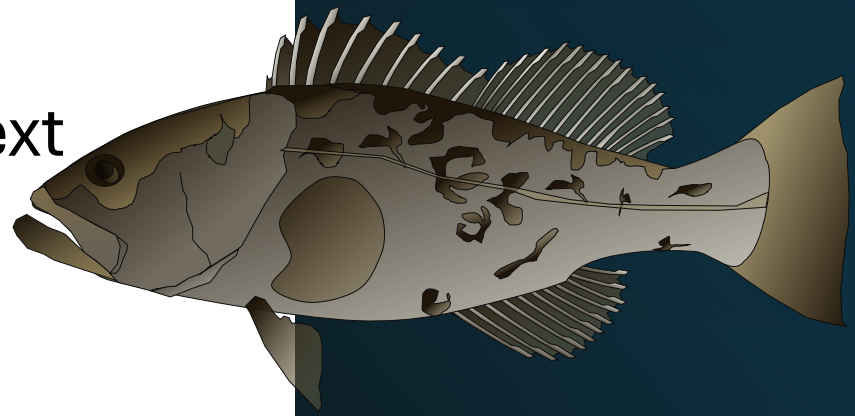

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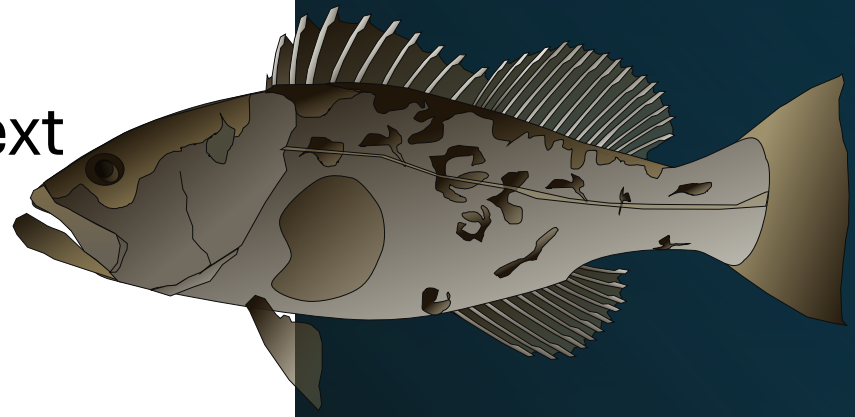
Does it work better?

- 25% lower RMSE when fit to full dataset
- 32% lower when predicting next year
- 18% lower when fit to datasets with next month removed (intra-season)
- For years with reduced seasons:
  - 57% more accurate predictions in 2023
  - 92% more accurate in 2024



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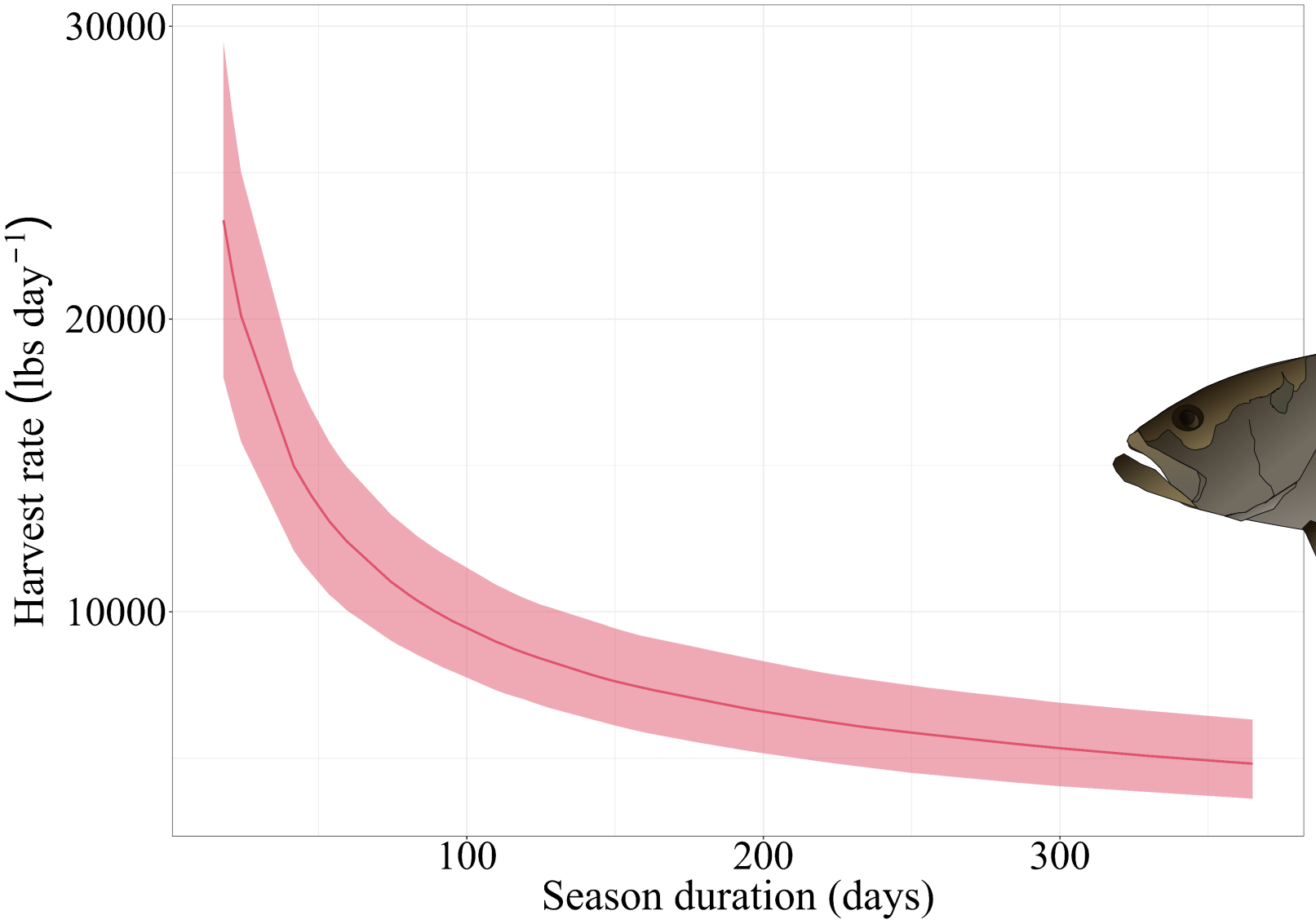

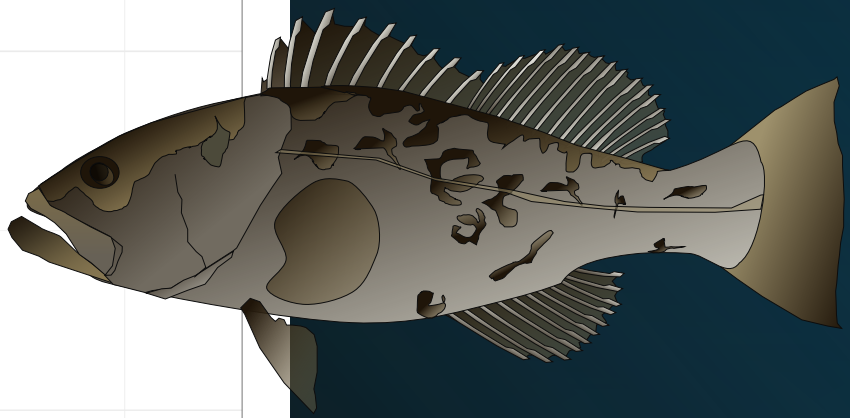

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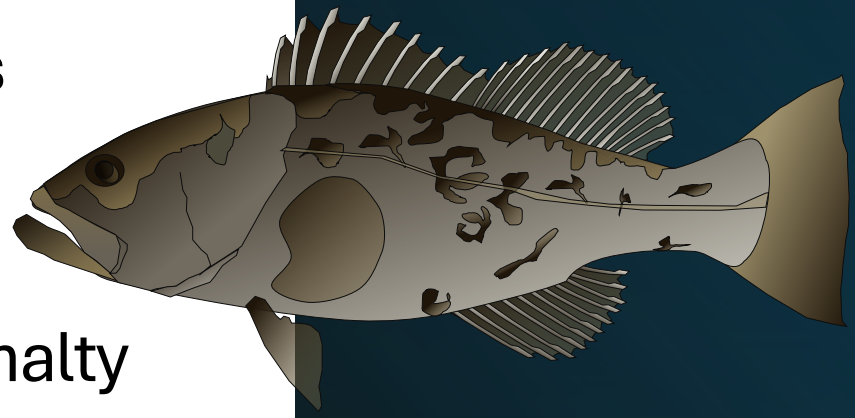
- Predicted a hypothetical 2025 season based on preliminary ACT

2024 Penalty = 2024 ACL – 2024 Harvest

= 163,000 lbs – 249,000 lbs = –86,000 lbs



2025 ACT = 2025 unadjusted ACT + 2024 Penalty

= 319,000 lbs – 86,000 lbs = **233,000 lbs**

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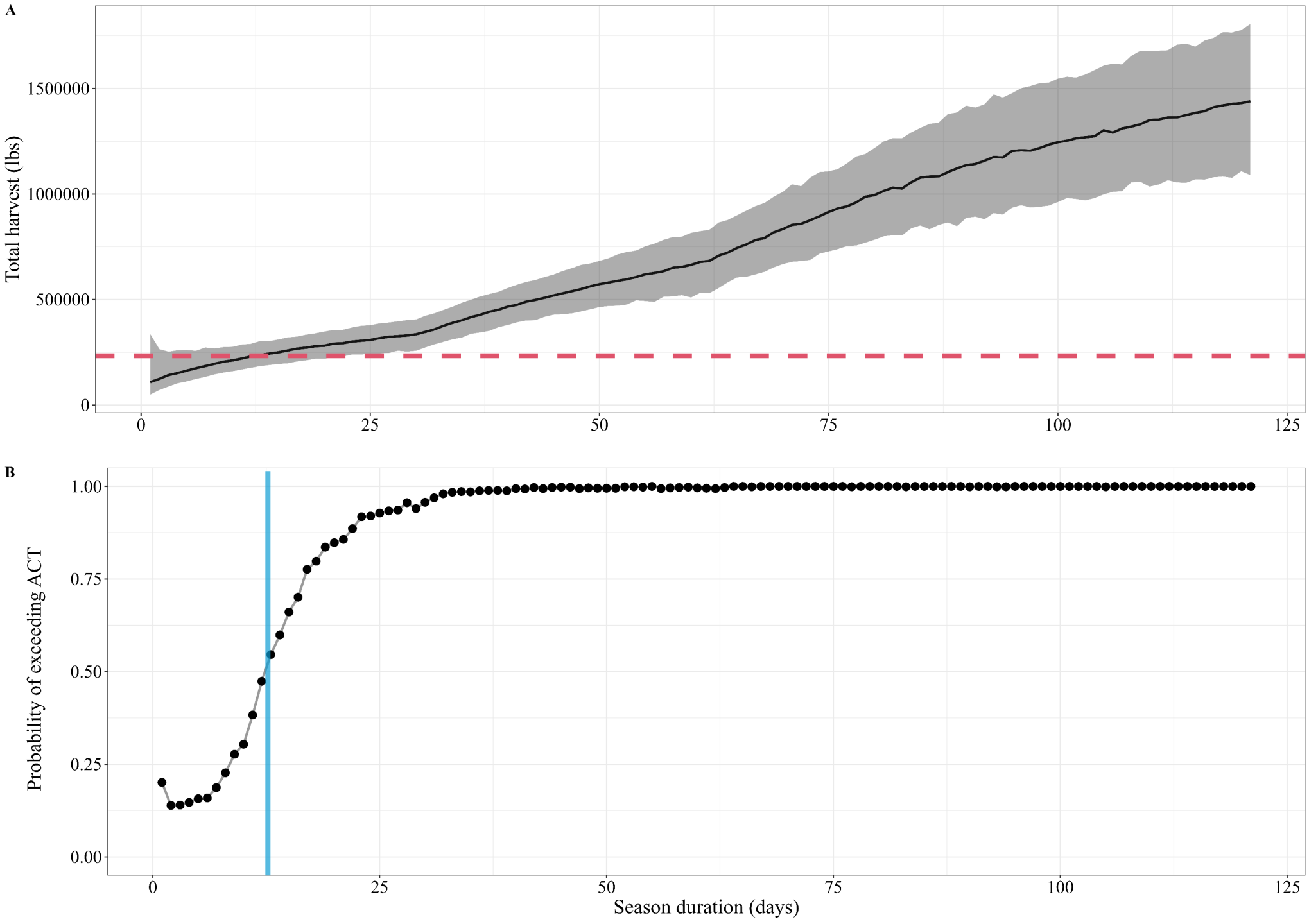
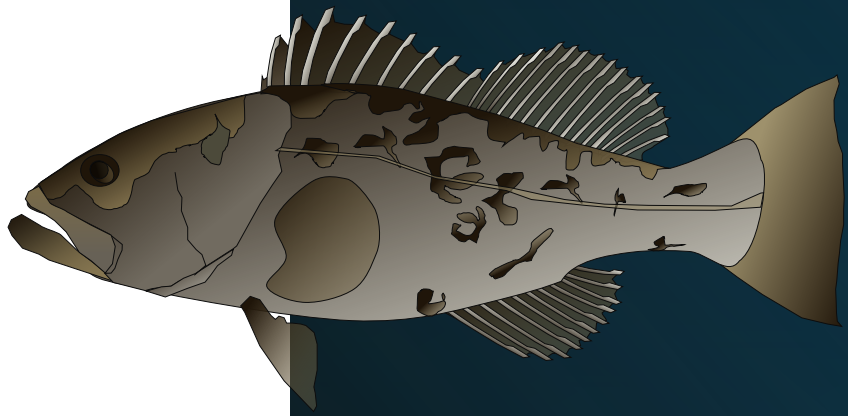

A
Total harvest (lbs)
1500000
1000000
500000
0
0
25
50
75
100
125
B
Probability of exceeding ACT
1.00
0.75
0.50
0.25
0.00
0
25
50
75
100
125
Season duration (days)

- Model is demonstrable improvement over current season projection methods



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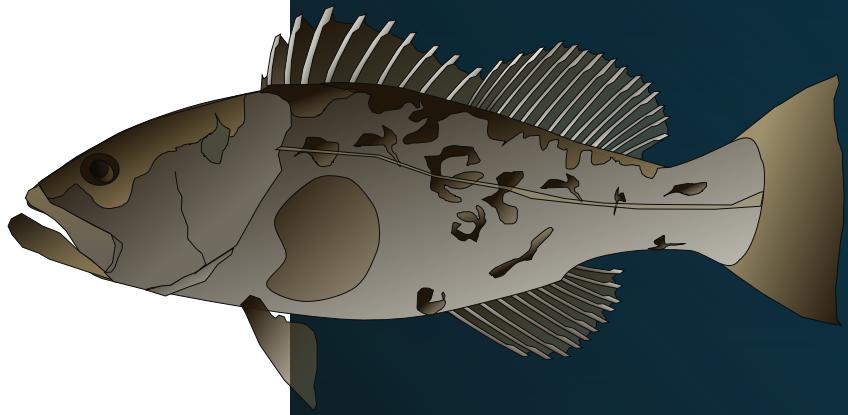
- Model is demonstrable improvement over current season projection methods
  - Due in large part because of explicit modeling of effort compression



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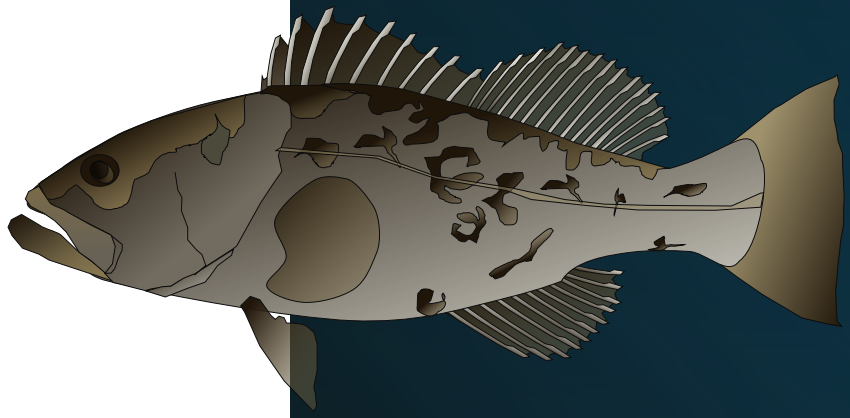
- Immediate use cases: Florida-centric species
  - Gag
  - Red grouper



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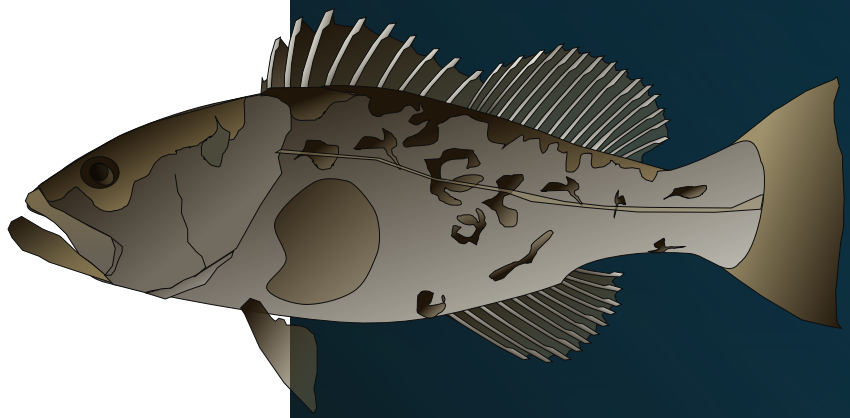
- Methodology can be adapted for broader applications:



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- Immediate use cases: Florida-centric species
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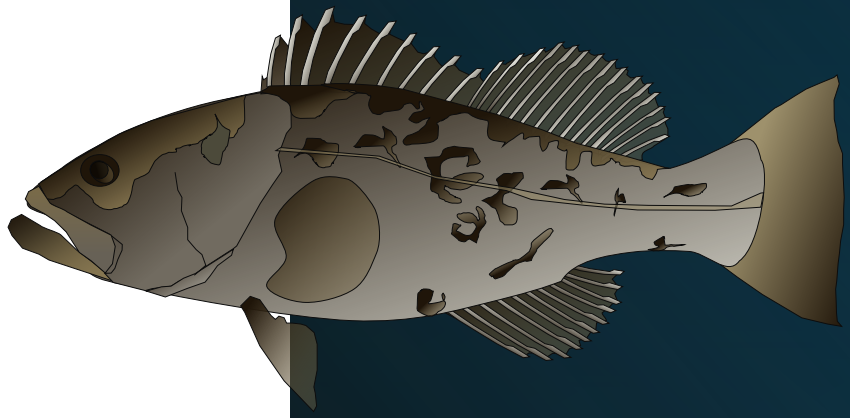
- Methodology can be adapted for broader applications:
  - At Gulf level, require harvest rates to be in the same format/currency as is used for management
  - Individual state-level predictions also possible



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Questions?

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