RDM discussion: computing next year's catch-per-trip

TC/MC meeting

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Overview

- To assess the effect of proposed 2024 mgt. measures on fishery output (e.g., total harvest), the RDM simulates 2024 fishing trips using historical trip-level data

- Example: a simulated fishing trip in 2024 is assigned a number of fish caught, and each fish is kept or discarded based on the length of the fish and the regulations

- How many fish are likely to be caught on that trip?

Overview

- Goal is generate catch-per-trip distribution for the management year (2024), from which we will draw a random number of fish caught per simulated trip

- Will use historical MRIP data on catch-per-trip by state, mode (private, for-hire, shore), and wave

- Issues:
  - MRIP wave 5 & 6 data will be missing for the most recent year (2023)
  - Given MRIP variability & sample sizes, should we aggregate using multiple years?

Overview

Three potential options to fill-in-data gaps/incorporate additional data years:

	MRIP data year for wave 2, 3, 4	MRIP data year for wave 5 and 6
Option 1	2023	2022
Option 2	2023 and 2022 weighted by 0.7 and 0.3	2022 and 2021 weighted by 0.7 and 0.3
Option 3	2023, 2022, 2021 weighted by 0.5, 0.3 and 0.2	2022, 2021, 2020 weighted by 0.5, 0.3 and 0.2

Formula for adjusting the sampling weights

Mean catch-per-trip in wave *w* is computed as:

$$\overline{y}^{w} = \frac{\sum_{i}^{I} (y_i * w_i)}{\sum_{i=1}^{I} w_i}$$

where $w_i = 1/\pi_i$ and π_i is the MRIP sample inclusion probability. The sample weight w_i is the number of trips in the population that observation *i* represents. Re-weighted sample weights based on additional waves of data are computed as:

$$\tilde{w}_{iy}^{w} = \frac{\sum_{i}^{I} (w_i)}{\sum_{y}^{Y} \sum_{i}^{I} w_{iy}} * p * w_i$$

where *p* is the desired weight given to observations in that year (ex, 0.7 if year = *y*, 0.3 if year = *y-1*)

Example of sample weight re-weighting under option 2

Table: Example of sample re-weighting under option 2

year	wave	SF catch	w_i	p	$\frac{\sum_i^I (w_i)}{\sum_y^Y \sum_i^I w_{iy}}$	$\frac{\sum_i^I (w_i)}{\sum_y^Y \sum_i^I w_{iy}} * p * w_i$
2020	5	2	100	0.3	2	60
2020	5	1	100	0.3	2	60
2020	5	0	100	0.3	2	60
2020	5	2	100	0.3	2	60
2020	5	5	100	0.3	2	60
2021	5	0	100	0.7	2	140
2021	5	8	100	0.7	2	140
2021	5	1	100	0.7	2	140
2021	5	3	100	0.7	2	140
2021	5	0	100	0.7	2	140

- Mean SF catch per trip option 1 (only use 2021) =2.4
- Mean SF catch per trip option 2 (use 2021 and 2020) =2.28

Illustrating the different approaches

- The following examples show estimates of mean/total catch-per-trip on trips that caught or primarily targeted fluke, sea bass, or scup across the three options

- Examples use 2023 as management year, in which case 2022 would be the most recent MRIP year so we exclude 2022 waves 5 and 6 to replicate data availability constraints

- As we use more years of data:
  - standard errors typically get smaller
  - fewer waves with missing data provides more non-zero catch estimates

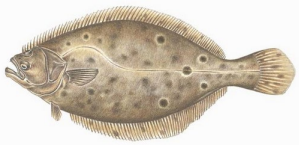
Illustrating the different approaches

The examples apply the following weighting scheme:

	MRIP data year for wave 2, 3, 4	MRIP data year for wave 5 and 6
Option 1	2022	2021
Option 2	2022 and 2021 weighted by 0.7 and 0.3	2021 and 2020 weighted by 0.7 and 0.3
Option 3	2022, 2021, 2020 weighted by 0.5, 0.3 and 0.2	2021, 2020, 2012 weighted by 0.5, 0.3 and 0.2

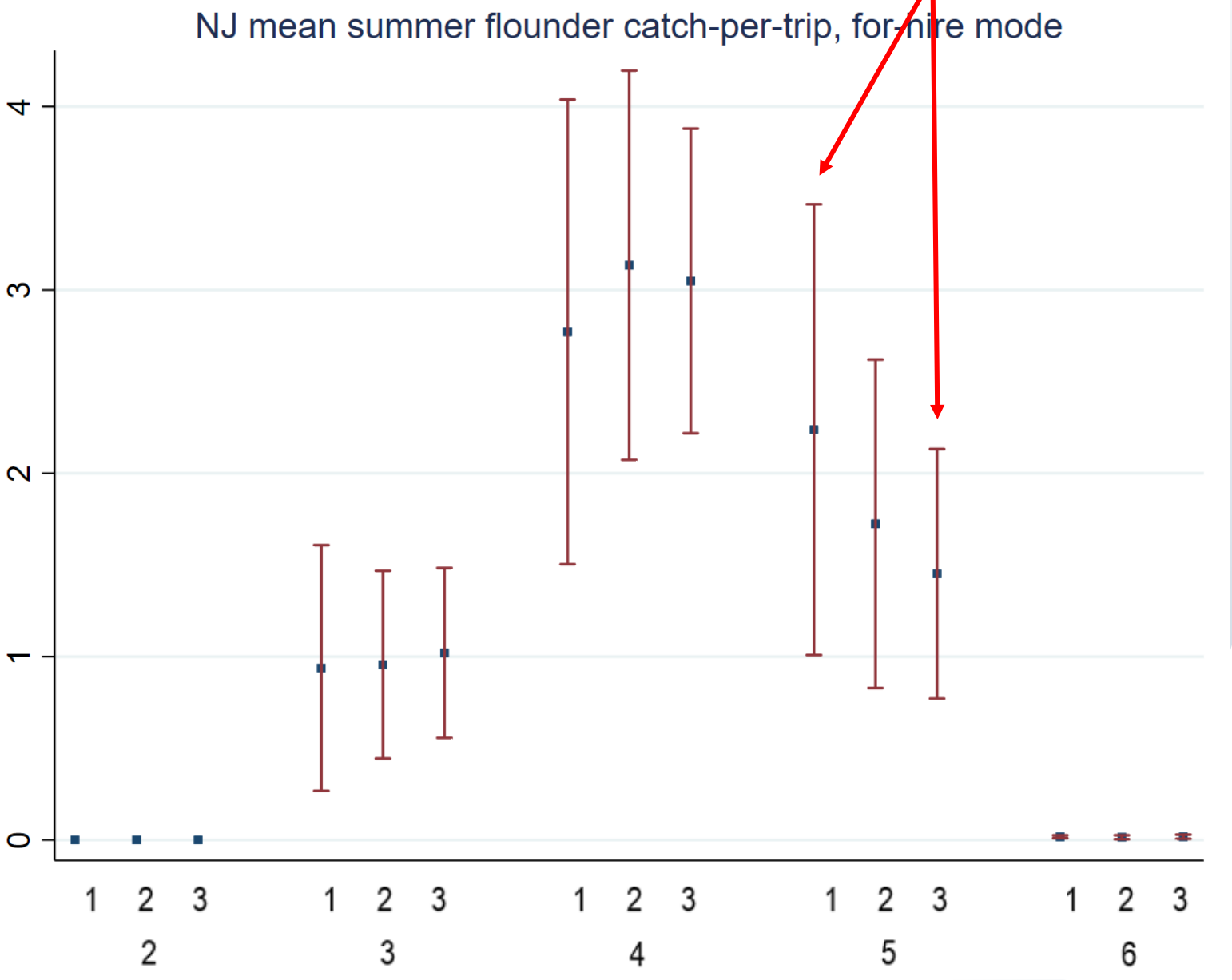
Illustrating the different approaches

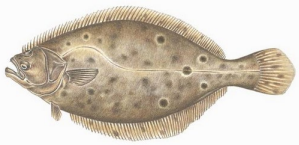
- Options 2 and 3 specify up to three years of data per wave
- In some cases there was no MRIP sampling during one or more of those years for a given wave
- Of the 113 combinations of state, mode, wave in our example:
  - 61 have data for all three years, 47 have two years, 5 have one year only
  - Missing years of wave-level data concentrated among waves 5, 6
- When additional wave-level data are missing, we revert to using two weighted years of data with the most recent year weighted more heavily or one unweighted year
- Alternative option to deal with missing data years is to pull additional historical data until there exists data for the specified # of years



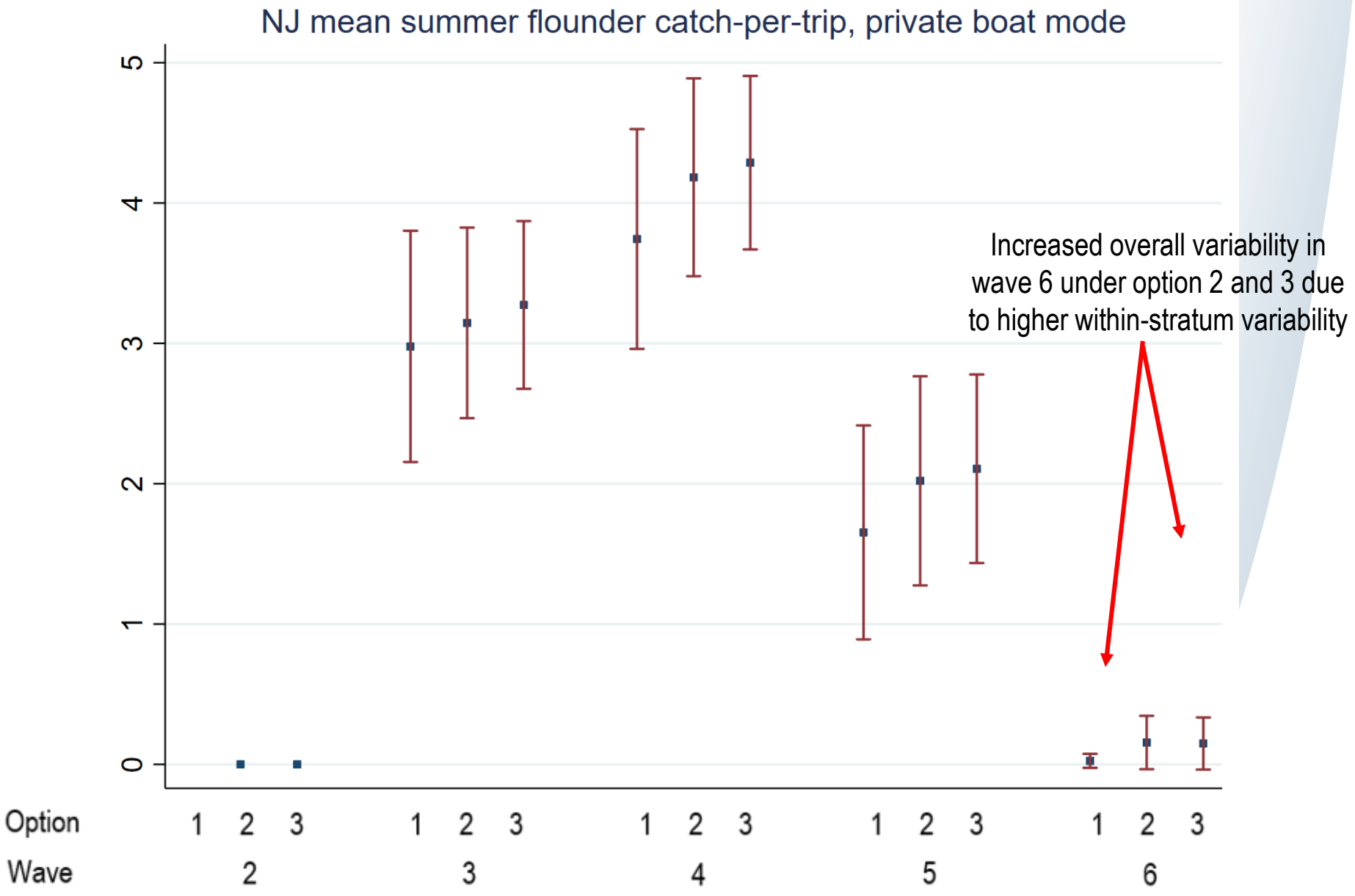
New Jersey

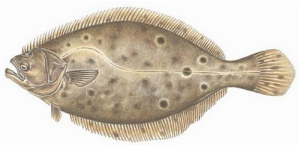
Mean catch in wave 5 is ~33% lower using 3 years of data



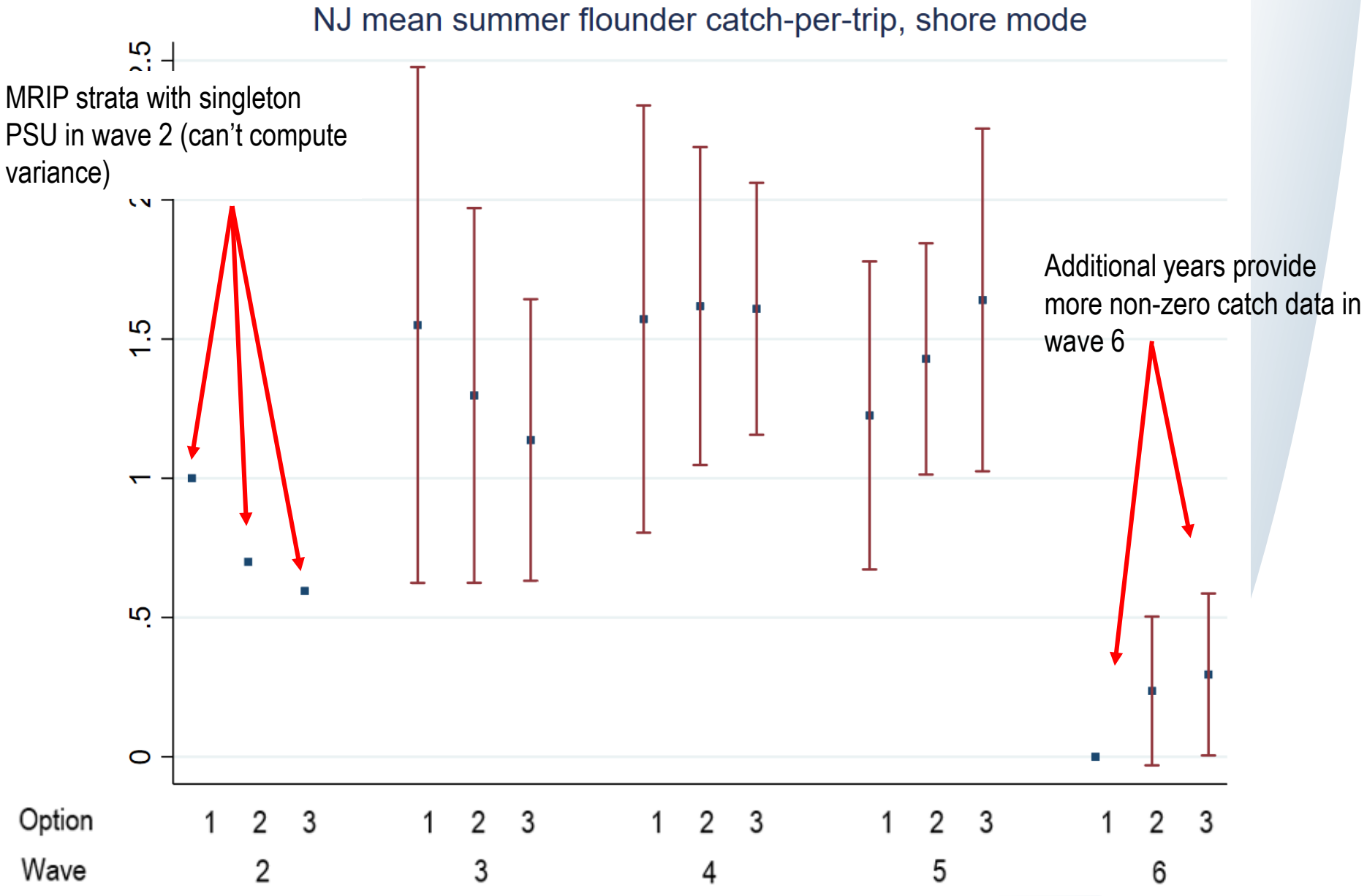


New Jersey

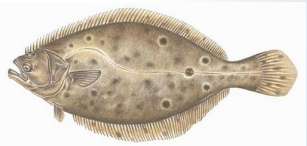

NJ mean summer flounder catch-per-trip, private boat mode
0
1
2
3
4
5
Increased overall variability in wave 6 under option 2 and 3 due to higher within-stratum variability
Option
1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
Wave
2 3 4 5 6



New Jersey


NJ mean summer flounder catch-per-trip, shore mode
MRIP strata with singleton PSU in wave 2 (can't compute variance)
Additional years provide more non-zero catch data in wave 6
0
.5
1
1.5
Option
1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
Wave
2 3 4 5 6

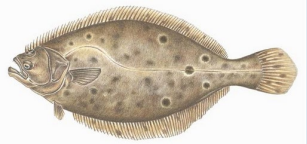
How does total catch vary across options?

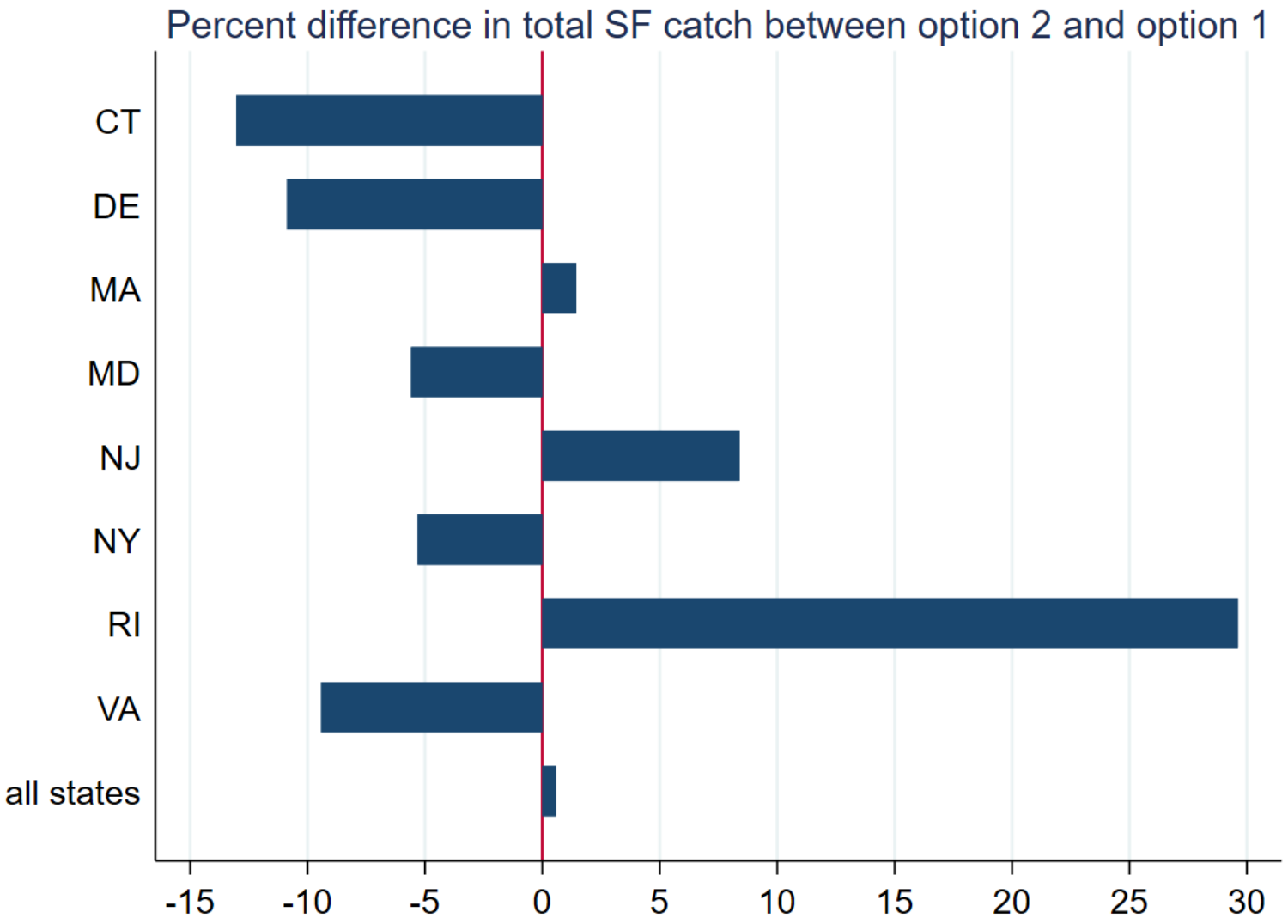


- Here we assume that the # of trips in options 2 and 3 is the same as option 1

stat	state	mode	option	total catch	% diff from option 1
SF total catch	NJ	fh	1	252,685	
SF total catch	NJ	fh	2	259,680	2.77
SF total catch	NJ	fh	3	256,624	1.56
SF total catch	NJ	pr	1	8,646,304	
SF total catch	NJ	pr	2	9,593,646	10.96
SF total catch	NJ	pr	3	9,848,155	13.90
SF total catch	NJ	sh	1	2,754,790	
SF total catch	NJ	sh	2	2,779,273	0.89
SF total catch	NJ	sh	3	2,691,513	-2.30
SF total catch	NJ	all modes	1	11,653,778	
SF total catch	NJ	all modes	2	12,632,599	8.40
SF total catch	NJ	all modes	3	12,796,292	9.80

How does total catch vary across options?





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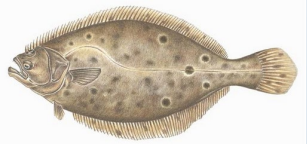

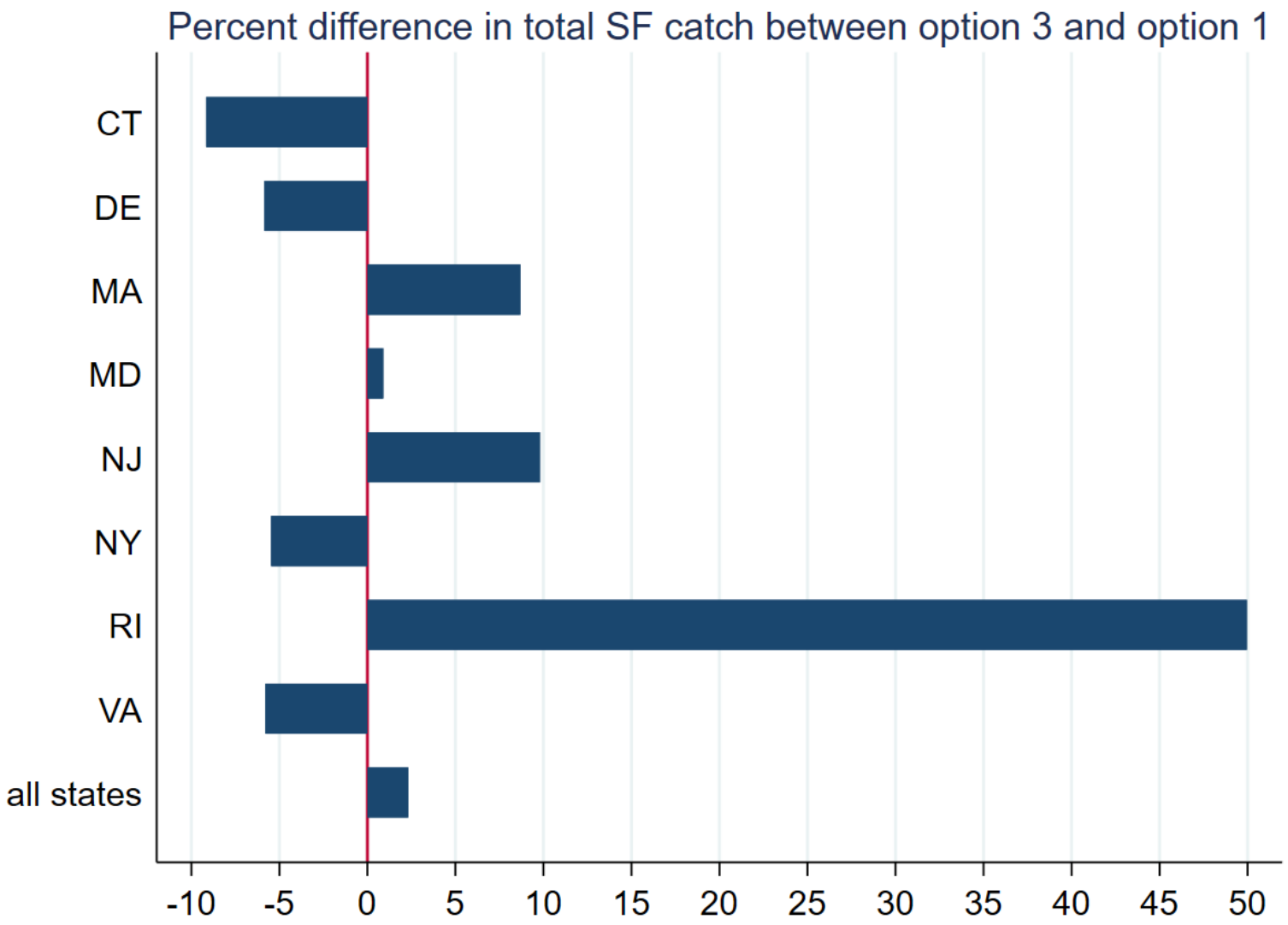

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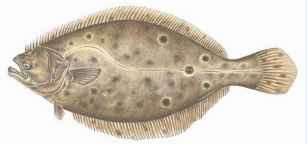
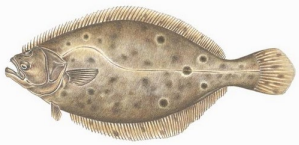


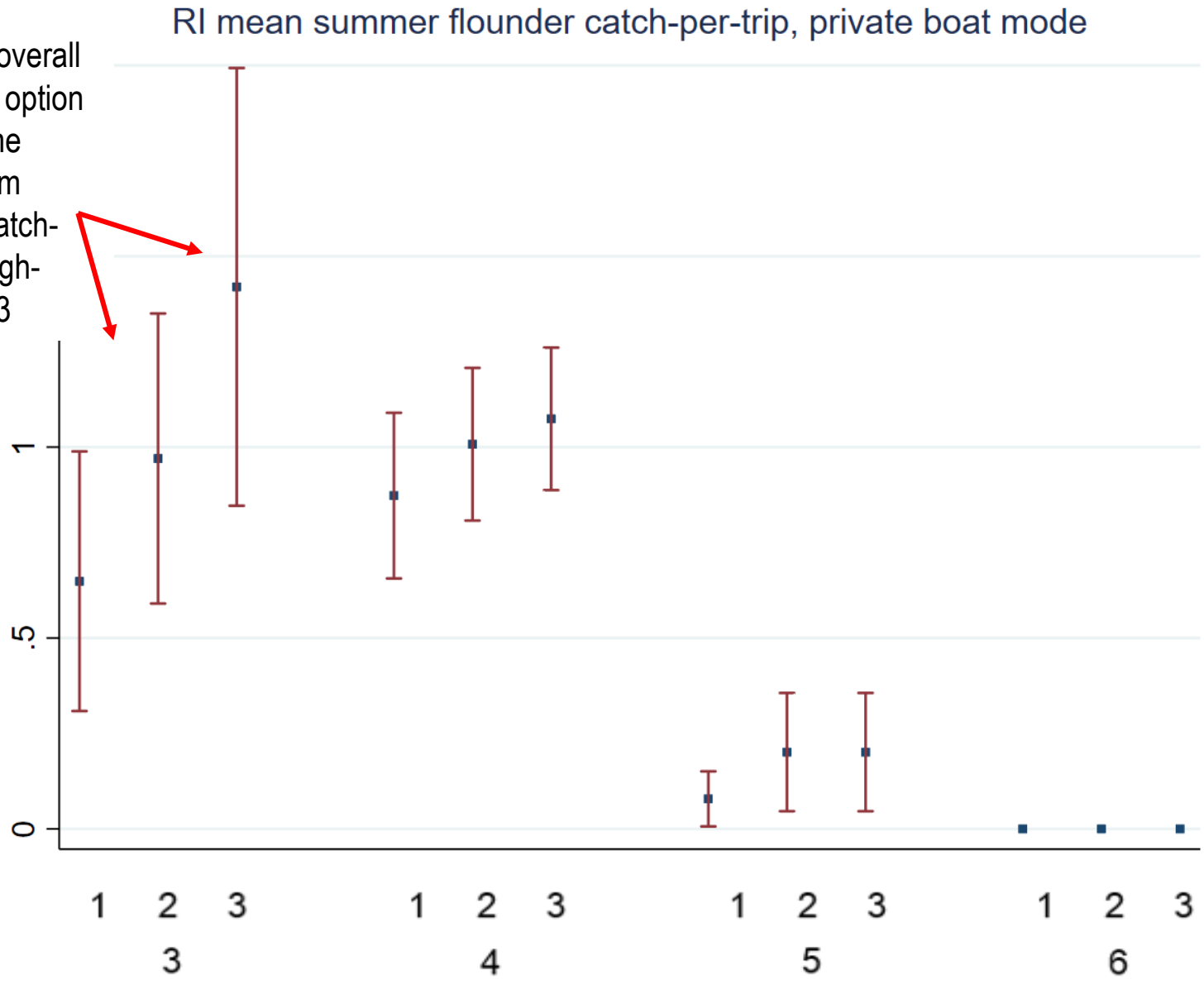
- Here we assume that the # of trips in options 2 and 3 is the same as option 1

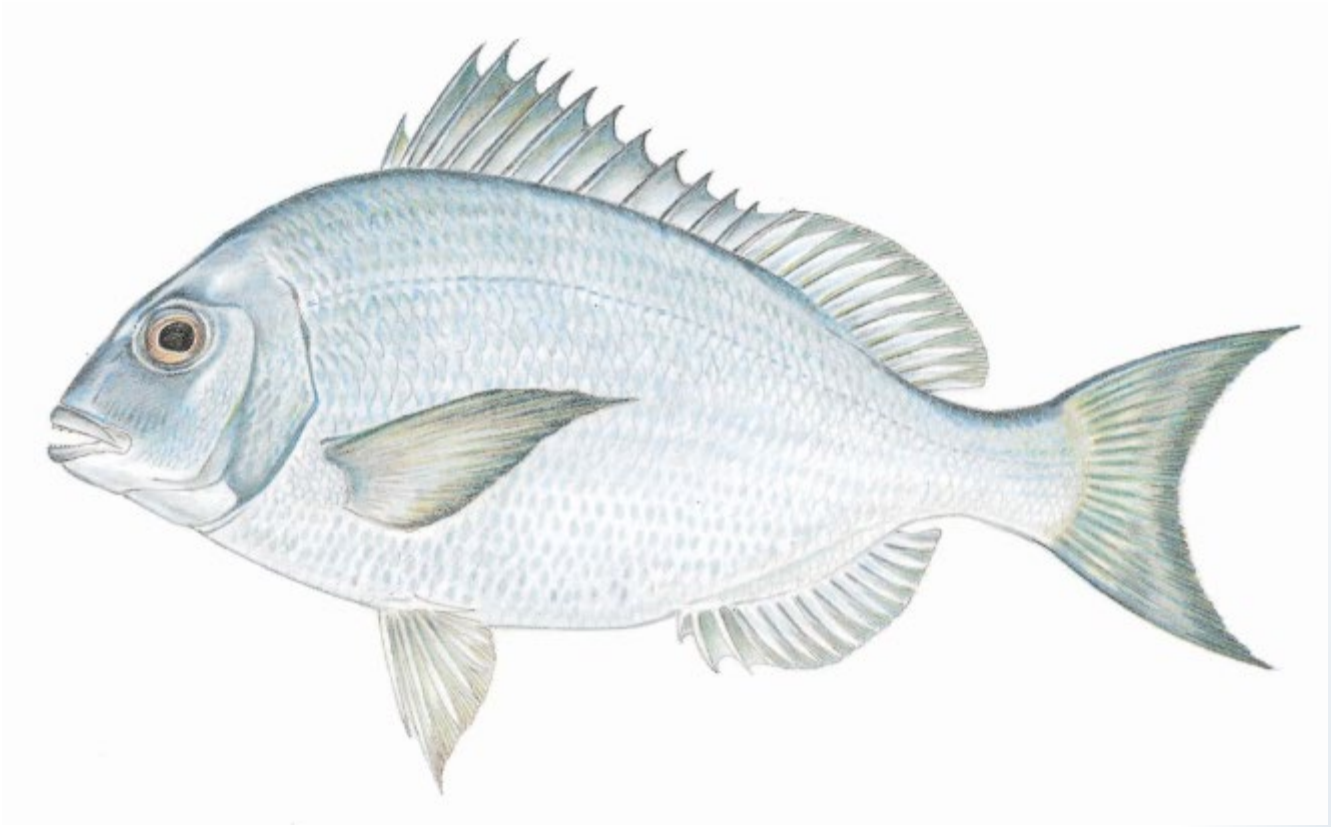
stat	state	mode	option	total catch	% diff from option 1
SF total catch	RI	fh	1	19,662	
SF total catch	RI	fh	2	17,766	-9.64
SF total catch	RI	fh	3	18,166	-7.6
SF total catch	RI	pr	1	385,146	
SF total catch	RI	pr	2	498,254	29.3
SF total catch	RI	pr	3	573,202	48.8
SF total catch	RI	sh	1	17,233	
SF total catch	RI	sh	2	31,042	80.1
SF total catch	RI	sh	3	41,525	140.9
SF total catch	RI	all modes	1	422,041	
SF total catch	RI	all modes	2	547,063	29.6
SF total catch	RI	all modes	3	632,893	49.9



Rhode Island

Increase in overall catch under option 2 and 3 come primarily from increased catch-per-trip in high-effort wave 3





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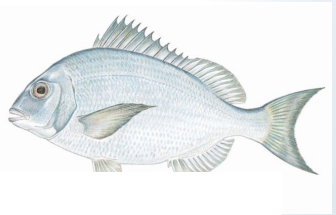

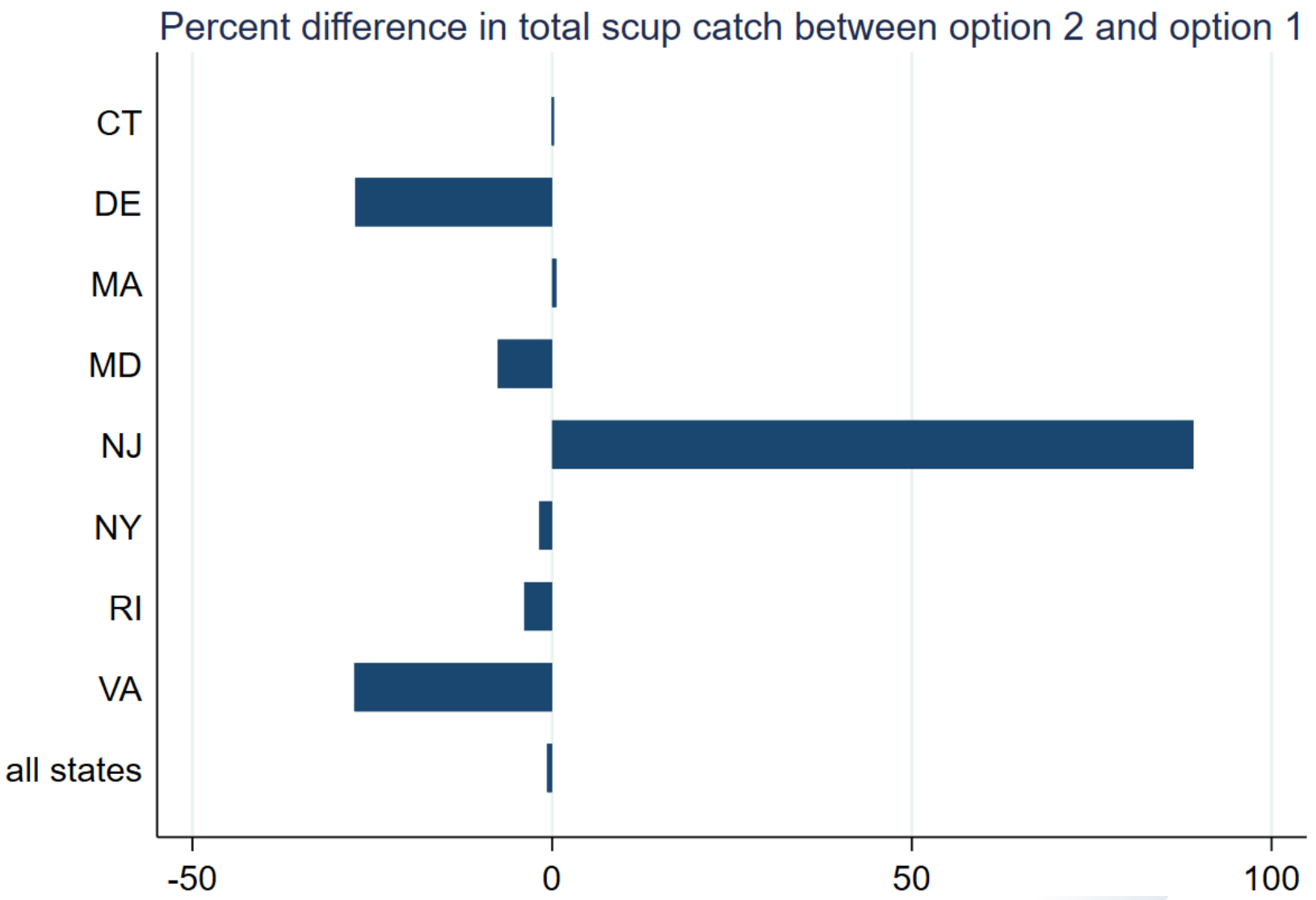

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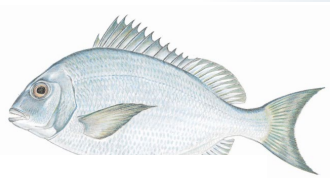
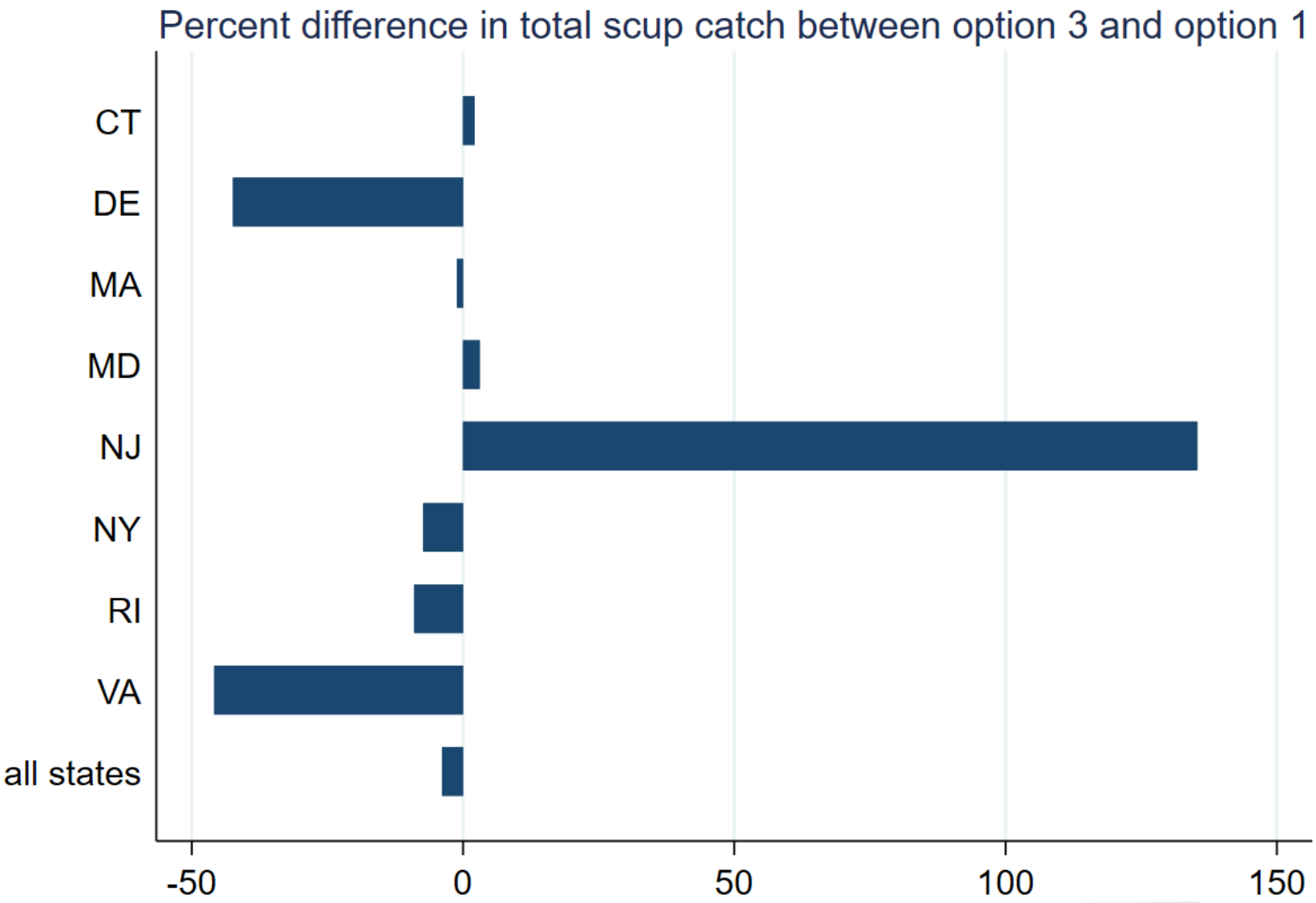
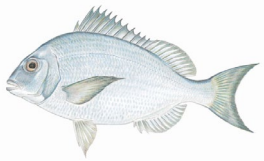
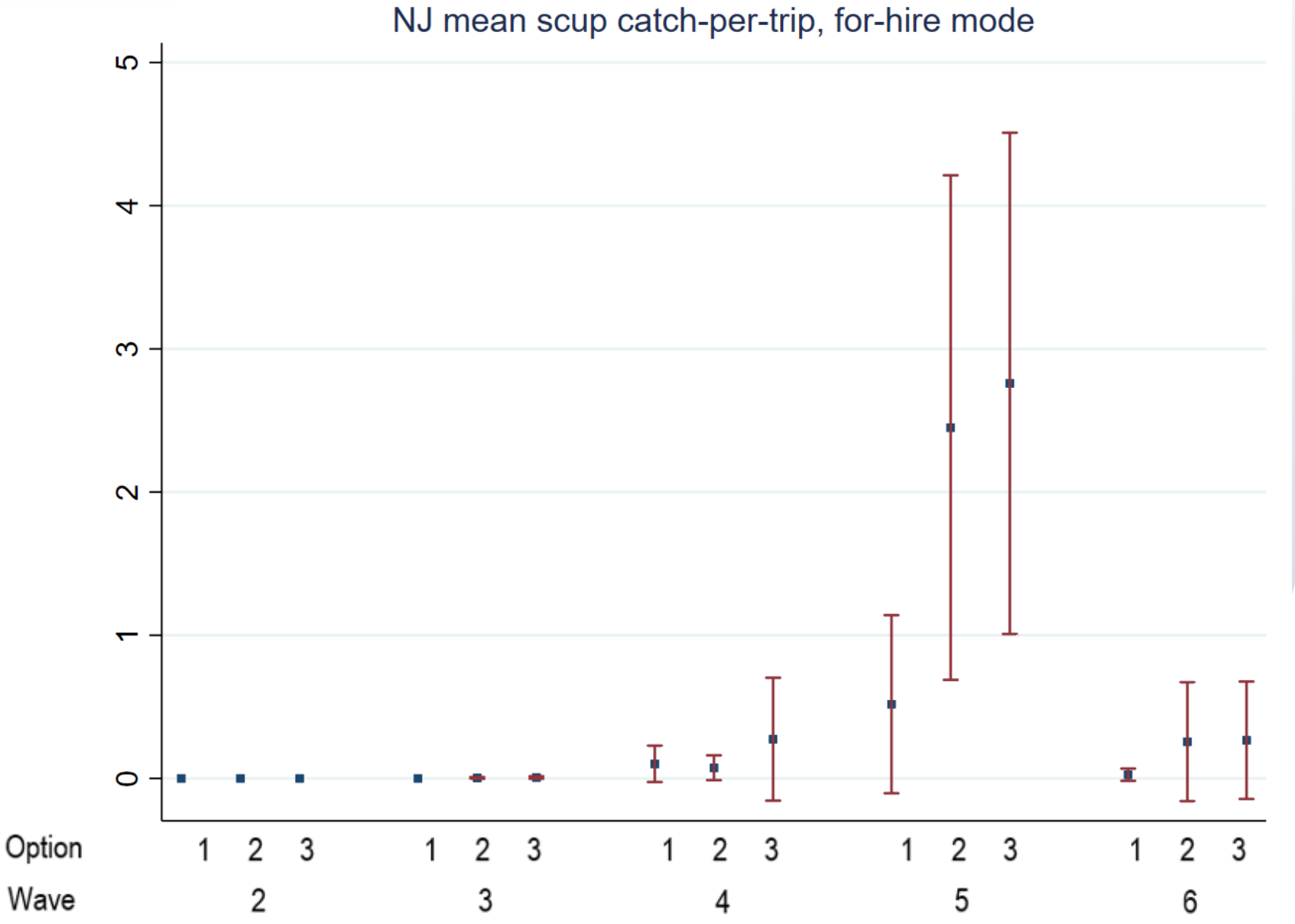
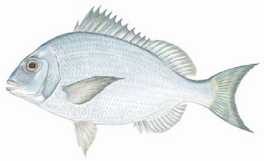




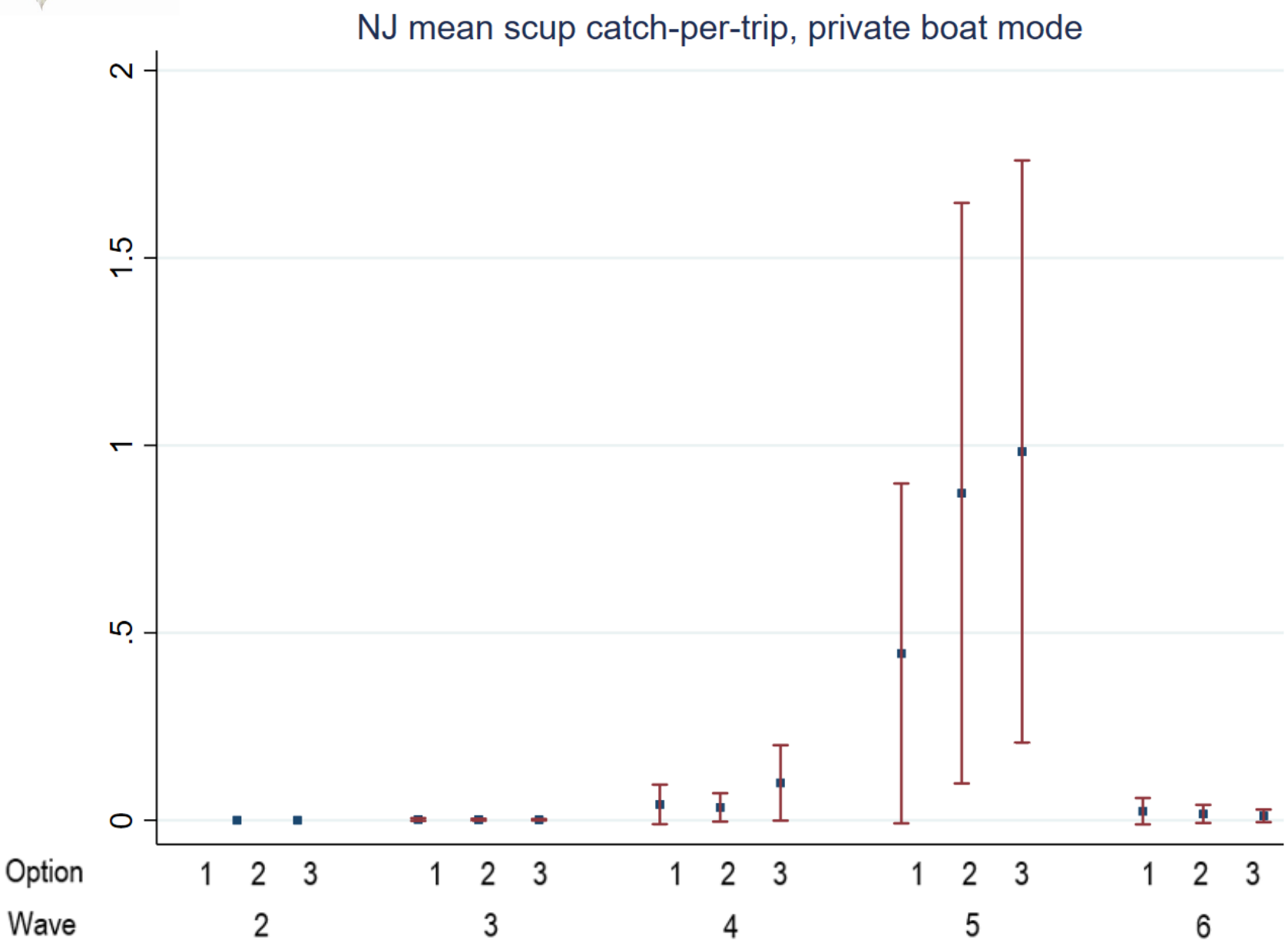


New Jersey

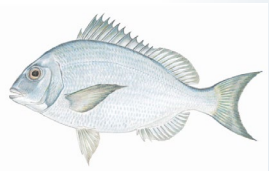

NJ mean scup catch-per-trip, for-hire mode
0
1
2
3
4
5
Option
1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
Wave
2
3
4
5
6



New Jersey


NJ mean scup catch-per-trip, private boat mode
2
1.5
1
.5
0
Option
1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
Wave
2
3
4
5
6

How does total catch vary across options?

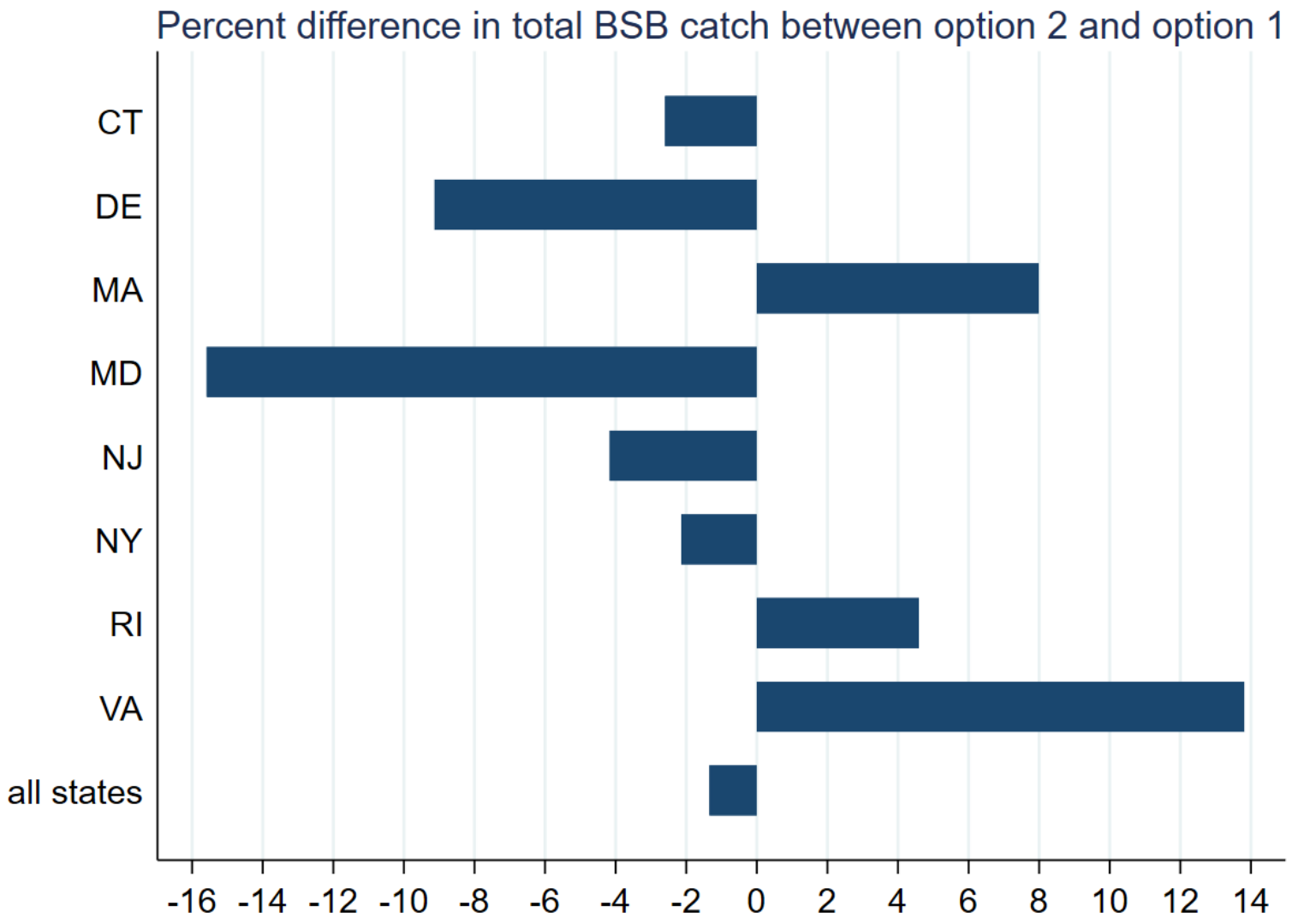


- Here we assume that the # of trips in options 2 and 3 is the same as option 1

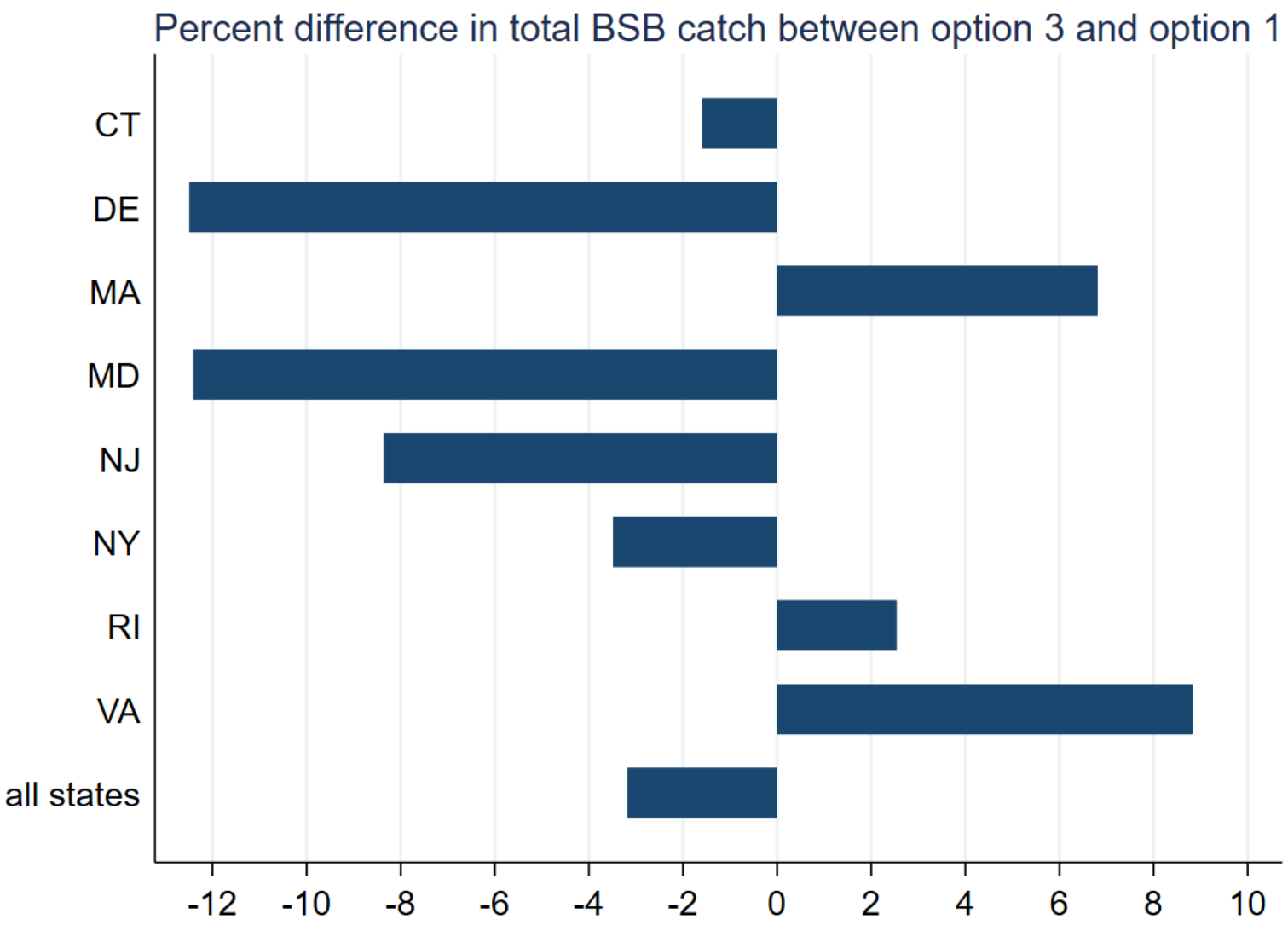
stat	state	mode	option	total catch	% diff from option 1
scup total catch	NJ	fh	1	20,927	0
scup total catch	NJ	fh	2	76,847	267
scup total catch	NJ	fh	3	97,384	365
scup total catch	NJ	pr	1	353,286	0
scup total catch	NJ	pr	2	631,036	78
scup total catch	NJ	pr	3	783,387	121
scup total catch	NJ	sh	1	0	
scup total catch	NJ	sh	2	0	N/A
scup total catch	NJ	sh	3	0	N/A
scup total catch	NJ	all modes	1	374,213	
scup total catch	NJ	all modes	2	707,883	89
scup total catch	NJ	all modes	3	880,772	135


FishWatch.gov

How does total catch vary across options?



How does total catch vary across options?



Conclusion

- Example results are specific to the input data years
- Results will vary depending on the input data
- Precision generally increases with more data, with exceptions
- Disaggregating MRIP data to state-mode-wave reduces precision and data availability, adding more years helps “fill the gaps”