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# Red Snapper Catch Limits Derived Using Estimates of Absolute Abundance Obtained from a Re-analysis of the Great Red Snapper Count

Sustainable Fisheries Division, SEFSC

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# Purpose and Need

- The Great Red Snapper Count (GRSC) estimate of absolute abundance has been updated since the last time catch advice was considered (March 2021).
- Council requested that catch advice be produced and considered in light of the updated estimates of absolute abundance.
- GRSC catch advice was previously used to set the OFL but not adopted for setting the ABC which remains based on projections derived during SEDAR 52.

# GRSC catch advice

- General approach
  - Turn GRSC estimate of age 2+ into numbers-at-age by region (east/west).
  - Re-estimate fishing mortality rates through projections to estimate  $F$ -at-age by region
  - Use numbers-at-age,  $F$ -at-age, and mean landed weight-at-age to estimate catch

# Methods (age 2+ estimate)

- Two candidate estimates of absolute abundance were considered for this analysis
  - Re-analysis of the GRSC estimate with the random forest sampling design in Florida accounted for in the estimation procedure.
  - Post-stratification of the above data into shallow water (10-25 meter) and mid water (25-40 meter) depth strata.
    - TX – estimated mean density by new strata
    - MS/AL and LA – assumed density = 0 (10-25 meter strata)
    - FL – estimated mean density by new strata

# Methods (age 2+ estimate)

State/Region	Habitat Type	Post-stratification		GRSC	
		Number	CV(%)	Number	CV(%)
TX	Natural	7,037,443	36	7,037,443	36
	Artificial	417,761	21	417,761	21
	Uncharacterized Bottom	12,253,661	41	14,569,830	46
	Total	19,708,865		22,025,035	32
LA	Natural	3,852,652	43	3,852,652	43
	Artificial	3,849,325	15	3,849,325	15
	Uncharacterized Bottom	5,869,365	61	9,729,387	59
	Total	13,571,342		17,431,364	34
AL/MS	Natural	3,751,988	20	3,751,988	20
	Artificial	1,509,625	11	1,509,625	11
	Uncharacterized Bottom	2,271,625	51	3,199,472	51
	Total	7,533,238		8,461,085	21
FL	Natural & Uncharacterized Bottom	46,838,220	22	48,124,414	22
	Artificial	127,560	17	127,560	17
	Total	46,965,780		48,251,974	22
ALL	Pipeline	507,661	43	507,661	43
<b>Gulf of Mexico</b>		<b>88,286,887</b>		<b>96,677,118</b>	<b>14</b>

# Methods (age 2+ estimate)

- Florida natural and UCB split into components assuming 37.13% from natural reef and the rest from UCB.
  - Percentage derived from random forest model
- Pipeline abundance separated into ecoregions using proportions from original analysis
- 18% TX, 65% LA, 16% MS/AL, 1% FL

# Methods (age 2+ estimate)

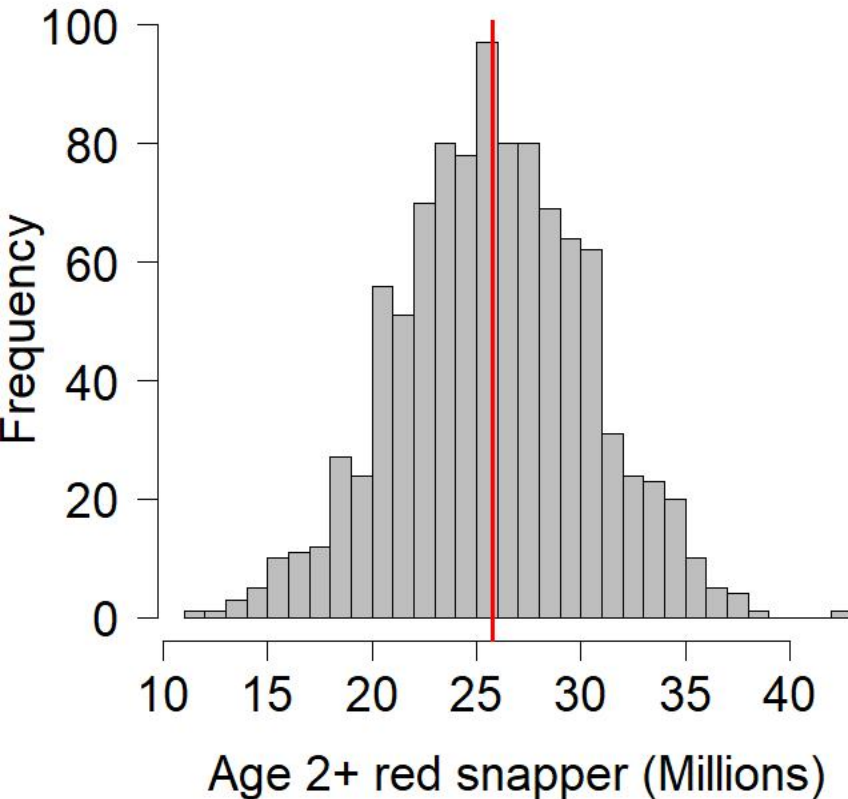
- 3 scenarios projected

		All Structure	All Structure + 10%	All Structure + 15%
GRSC estimate	East	23,344,070	26,689,599	28,362,364
	West	15,578,540	18,008,461	19,223,422
	Total	38,922,610	44,698,061	47,585,786
Post-stratification estimate	East	22,866,506	26,038,388	27,624,329
	West	15,578,540	17,390,842	18,296,994
	Total	38,445,046	43,429,230	45,921,322

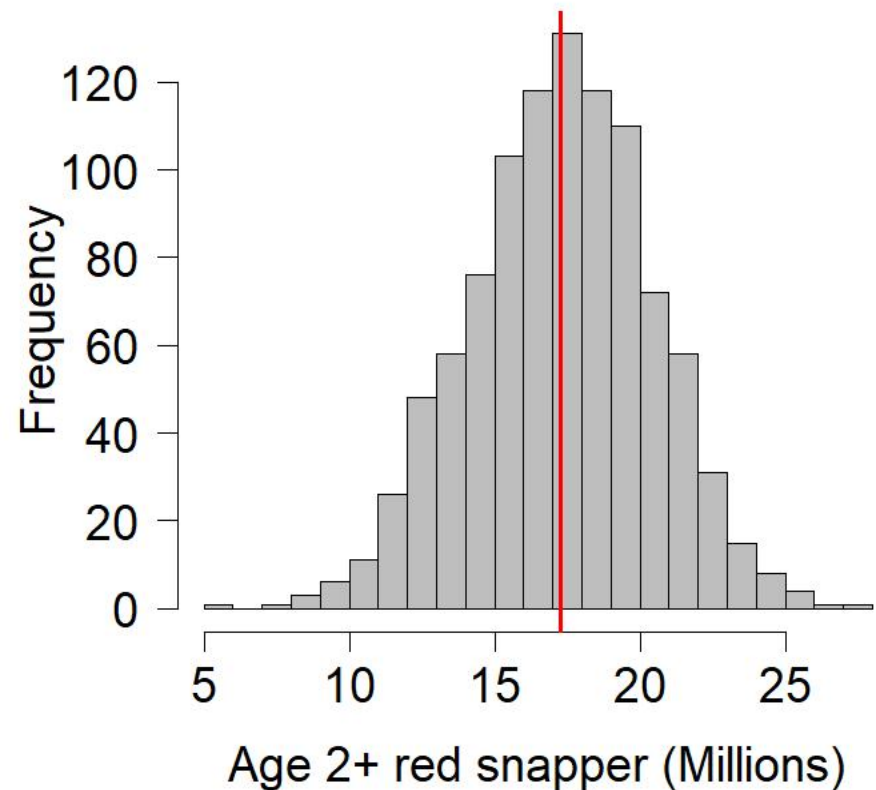
- (All Structure) - numbers from reefs (natural and artificial) and pipelines
- (All Structure +) - All Structure plus 10% or 15% of uncharacterized bottom

# Methods (age 2+ estimate; Monte Carlo)

Total number East Gulf AS10



Total number West Gulf AS10

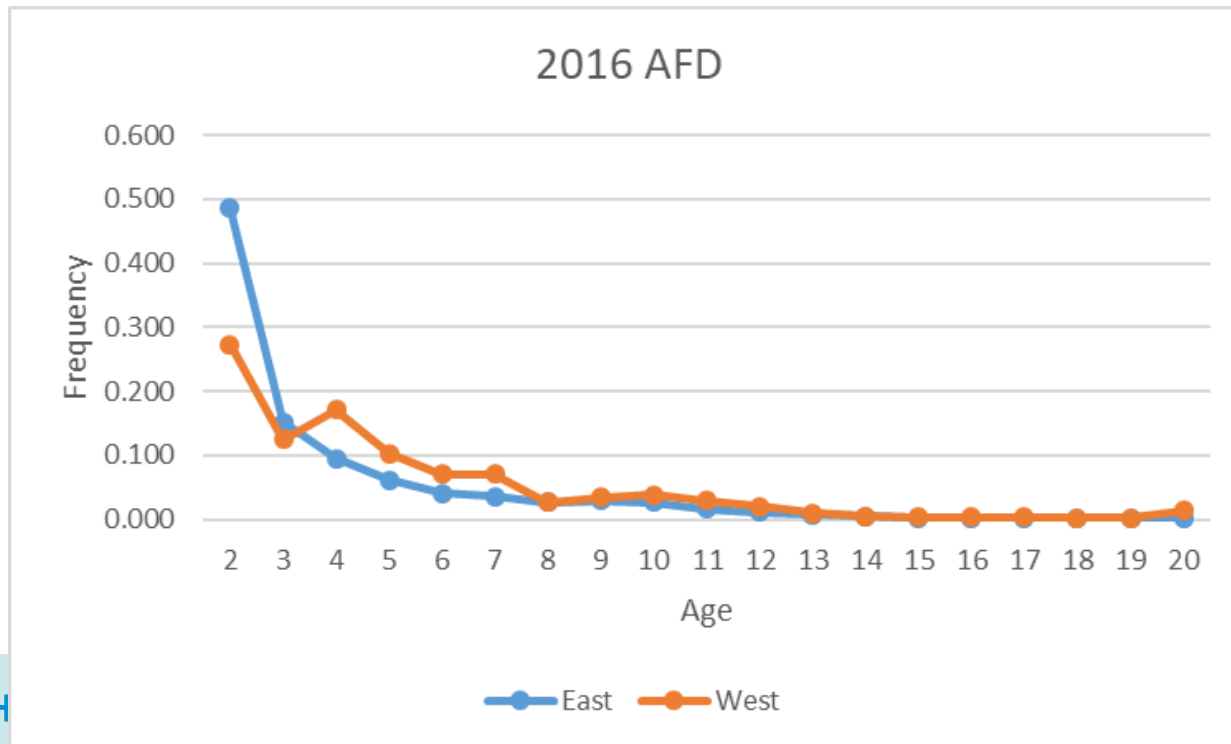


Example depicted from projection using all structure plus 10% UCB



# Methods (Numbers-at-Age)

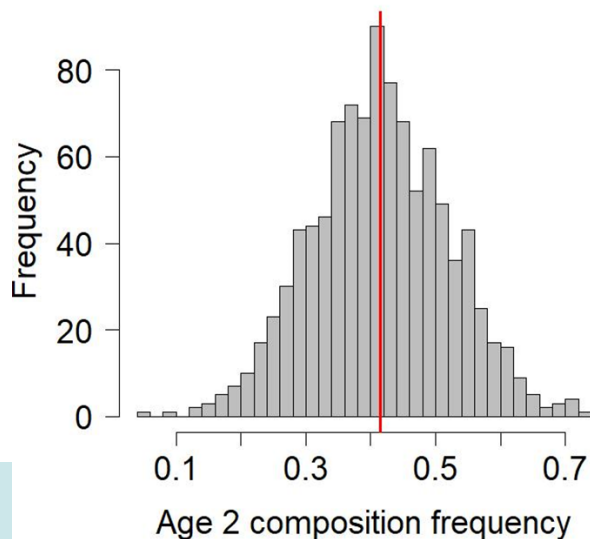
- GRSC subsets of 2+ fish needed to be separated by age.
- 2016 composition data from SEDAR 52 used to construct age 2+ age frequency distributions (AFDs) by area.
- 2016 last year fully informed by data



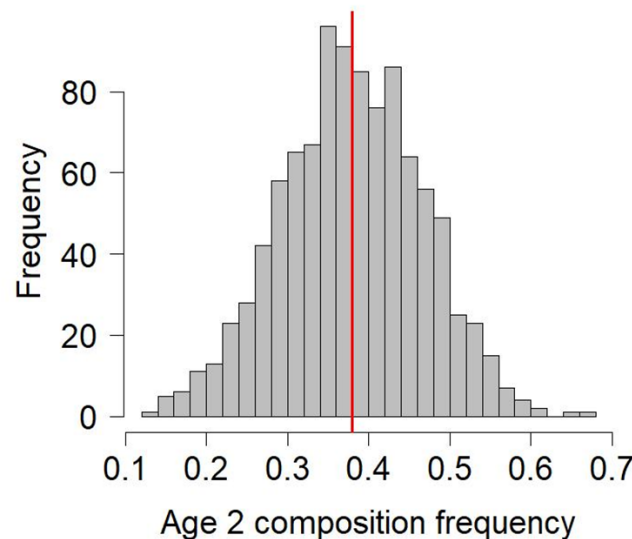
# Methods (Numbers-at-Age; Monte Carlo)

- Frequency of age 2 fish randomly selected assuming normal distribution with mean and SD determined by last 10 years of available data (2007-2016)
- Age 3 and older fish follow the distribution from 2016 rescaled to sum to one

East Gulf Recruitment AS10



West Gulf Recruitment AS10

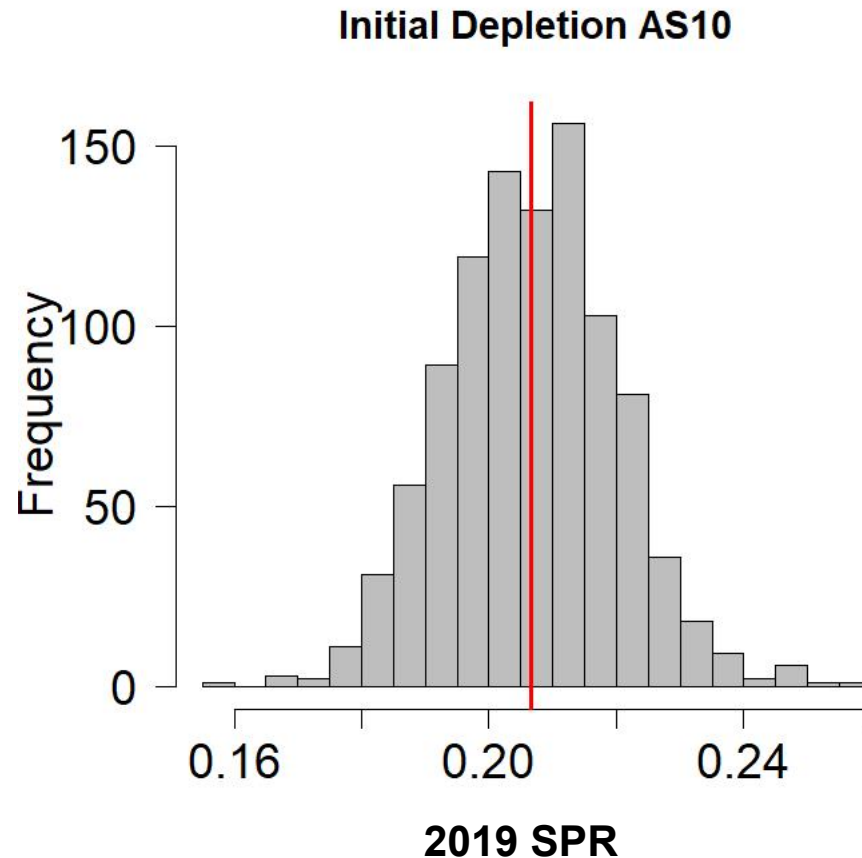


Example depicted from  
projection using All structure  
plus 10% UCB

# Methods (Initial depletion and SSB0)

- Needed a GRSC adjusted value of virgin biomass to carryout SPR based projections to re-estimate fishing mortality rates.
- $SSB0 = SSB2019 / SPR2019$
- SPR 2019 taken from SEDAR 52 (0.207, sd = 0.013)
- $SSB2019 = \sum_a fec_a mat_a N_a$ ; for ages 0-20+
- $fec$  = fecundity,  $mat$  = maturity,  $N$  = GRSC numbers

# Methods (Initial depletion and SSB0)



Example depicted from projection using All structure plus 10% UCB

# Methods (Fishing Mortality)

- 3 year average (2014 – 2016) fleet-specific  $F$ 's used to set relative relationship among the fleet  $F$ 's.
  - In Monte Carlo simulation fleet-specific  $F$ 's were randomly generated assuming a mean equal to the three year average and  $CV=0.1$
- Projections were used to adjust the magnitude of the directed fleet  $F$ 's to achieve SPR target in equilibrium.
- Catch was calculated using Baranov's catch equation with the estimates of  $F$ -at-age,  $M$ -at-age, GRSC numbers-at-age, and mean landed weight-at-age

# Results (Catch Advice)

- Catch produced by deterministic projections of  $F_{\text{SPR26\%}}$  and:
  - Projections of  $75\%F_{\text{SPR26\%}}$  for the directed fleets.
  - Incorporate uncertainty into the projections through Monte Carlo simulation and apply  $P^*$  approach to landings distribution.

# Results (Catch, deterministic projections)

$F_{\text{SPR26\%}}$

Year	All Structure		All Structure + 10%		All Structure + 15%	
	GRSC	Post-Strat	GRSC	Post-Strat	GRSC	Post-Strat
2022	19.41	19.13	22.26	21.65	23.69	22.92
2023	19.61	19.31	22.48	21.87	23.92	23.15
2024	19.84	19.54	22.75	22.14	24.20	23.43
2025	20.05	19.75	22.99	22.37	24.46	23.69
2026	20.20	19.89	23.16	22.54	24.64	23.86
3 yr. avg. ('22-'24)	19.62	19.33	22.50	21.89	23.94	23.17
5 yr. avg. ('22-'26)	19.82	19.52	22.73	22.11	24.18	23.41

$75\% F_{\text{SPR26\%}}$

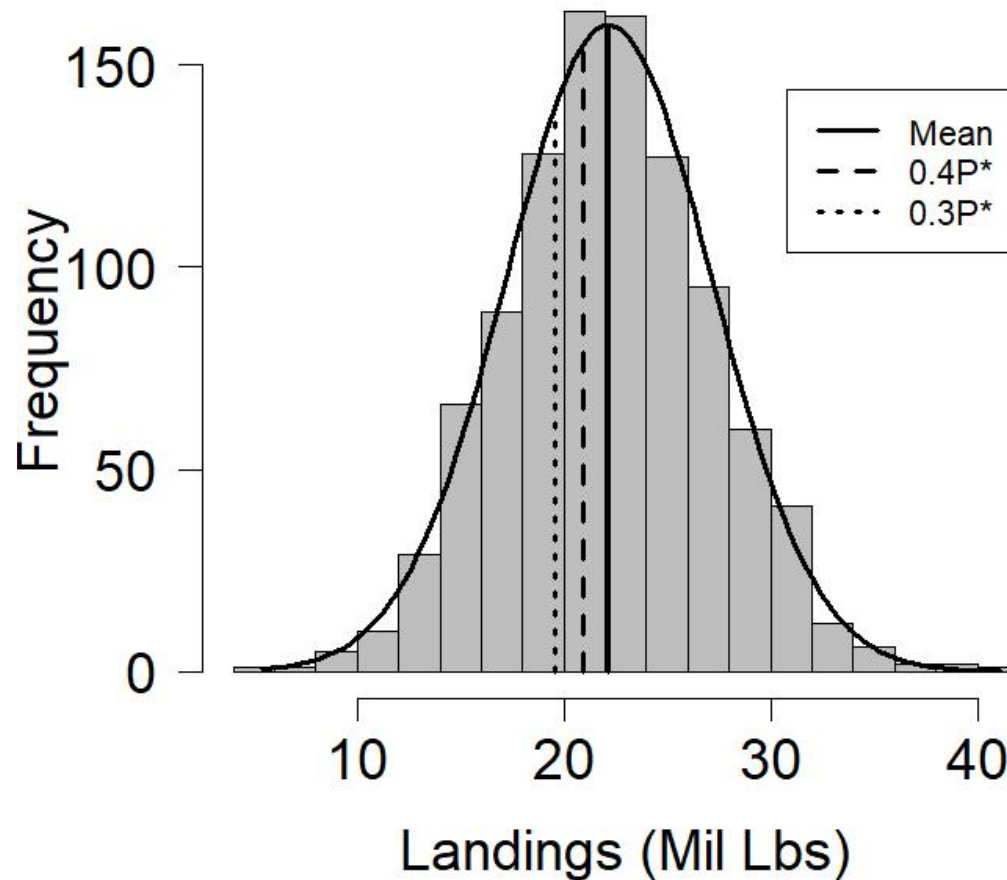
Year	All Structure		All Structure + 10%		All Structure + 15%	
	GRSC	Post-Strat	GRSC	Post-Strat	GRSC	Post-Strat
2022	17.05	16.81	19.56	19.02	20.81	20.13
2023	17.60	17.34	20.19	19.64	21.48	20.79
2024	18.09	17.82	20.74	20.18	22.07	21.37
2025	18.49	18.20	21.19	20.62	22.55	21.84
2026	18.76	18.47	21.50	20.93	22.88	22.16
3 yr. avg. ('22-'24)	17.58	17.32	20.16	19.62	21.45	20.76
5 yr. avg. ('22-'26)	18.00	17.73	20.64	20.08	21.96	21.26

- Catches are in millions of pounds ww and are landings and dead discards (i.e., no dead B2's)



# Results (Monte Carlo simulation)

Avg. Landings (2022-2026) AS10





### GRSC estimate

Year	All Structure				All Structure + 10%				All Structure + 15%			
	Mean	SD	P*0.4	P*0.3	Mean	SD	P*0.4	P*0.3	Mean	SD	P*0.4	P*0.3
2022	19.95	3.92	18.96	17.90	23.13	4.67	21.95	20.68	24.25	4.93	23.00	21.66
2023	19.81	4.35	18.71	17.54	23.02	5.10	21.73	20.34	24.06	5.44	22.68	21.21
2024	19.84	4.67	18.66	17.39	23.08	5.44	21.70	20.23	24.08	5.83	22.60	21.02
2025	19.89	4.88	18.65	17.33	23.16	5.66	21.73	20.19	24.13	6.09	22.59	20.94
2026	19.93	5.01	18.66	17.30	23.22	5.78	21.75	20.18	24.17	6.24	22.59	20.90
3 yr. avg. ('22-'24)	19.87	4.30	18.78	17.61	23.08	5.06	21.80	20.43	24.13	5.38	22.76	21.31
5 yr. avg. ('22-'26)	19.88	4.55	18.73	17.49	23.12	5.31	21.78	20.34	24.14	5.69	22.70	21.16

### Post-stratification estimate

Year	All Structure				All Structure + 10%				All Structure + 15%			
	Mean	SD	P*0.4	P*0.3	Mean	SD	P*0.4	P*0.3	Mean	SD	P*0.4	P*0.3
2022	19.87	3.80	18.90	17.87	22.23	4.33	21.13	19.96	23.74	4.79	22.53	21.23
2023	19.75	4.21	18.68	17.54	22.09	4.78	20.88	19.58	23.59	5.30	22.25	20.81
2024	19.79	4.52	18.65	17.42	22.13	5.12	20.83	19.44	23.62	5.69	22.18	20.64
2025	19.86	4.72	18.66	17.38	22.19	5.35	20.84	19.39	23.69	5.94	22.18	20.57
2026	19.90	4.84	18.68	17.36	22.24	5.48	20.85	19.36	23.73	6.09	22.19	20.54
3 yr. avg. ('22-'24)	19.80	4.17	18.75	17.62	22.15	4.73	20.95	19.67	23.65	5.24	22.32	20.90
5 yr. avg. ('22-'26)	19.83	4.40	18.72	17.53	22.17	4.99	20.91	19.56	23.68	5.54	22.27	20.77

- Catches are in millions of pounds ww and are landings and dead discards (i.e., no dead B2's)



# Final Thoughts

- Projections capable of running additional scenarios on request
  - % F
  - $P^*$
  - Alternate 2+ scenarios (e.g., 20%UCB etc.)
  - LGL Louisiana data if available
- While we attempted to incorporate uncertainty into the catch advice the full scientific uncertainty was not captured in this analysis.

# Thank You



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