Evaluation of Measurement Error

- Report describes studies that evaluated the Fishing Effort Survey for possible measurement errors and resulting bias:

  - Questionnaire development
  - Evaluation of one-month waves
  - Question order effects

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Questionnaire Development

- Tested several questionnaire versions that differed in number of reference periods
- Single 2-month period (unbounded) versus multiple discrete periods (bounded)
- Conducted "cognitive interviews"

11. In the past 2 months, between March 1 and April 30, 2013, on how many days did this household member go recreational saltwater fishing in North Carolina from:

a. The shore – include docks, bridges, causeways, beaches, banks or any other shore-based structure or area.

Days fished from shore
Enter "0" if none.

b. A boat – include a private or rental boat that returned to shore in North Carolina. Do not include charter boats - rental or commercial boats that include a captain or crew who help locate and catch fish.

Days fished from a private boat
Enter "0" if none.

11. For each time period below, on how many days did this person go recreational saltwater fishing in Maryland from:

a. The shore – include docks, bridges, causeways, beaches, banks or any other shore-based structure or area. Enter "0" if none.

Days in March and April, 2013

Days in Jan. and Feb., 2013

Days in Sept., Oct., Nov., Dec., 2012

Days in May, June, July, Aug., 2012

b. A boat – include a private or rental boat that returned to shore in Maryland. Do not include charter boats - rental or commercial boats that include a captain or crew who help locate and catch fish. Enter "0" if none.

Days in March and April, 2013

Days in Jan. and Feb., 2013

Days in Sept., Oct., Nov., Dec., 2012

Days in May, June, July, Aug., 2012

Questionnaire Development

- Bounded design resulted in lower prevalence estimates in 9 of 10 comparisons

Measure	Q1 (unbounded) % (SE)	Q2 (bounded) % (SE)	Relative difference	p-value
Shore prevalence				
Overall	9.42 (0.62)	9.27 (0.62)	1.59	0.8659
FL	16.20 (1.31)	19.34 (1.43)	-19.40	0.105
MA	6.61 (1.15)	3.40 (0.81)	48.65	0.022
NY	4.76 (0.87)	3.13 (0.77)	34.20	0.1602
NC	7.37 (1.35)	5.86 (1.19)	20.50	0.402
Boat prevalence				
Overall	7.54 (0.55)	4.92 (0.43)	34.75	0.0002
FL	13.39 (1.18)	11.62 (1.12)	13.27	0.2731
MA	4.17 (0.81)	1.38 (0.51)	67.00	0.0035
NY	4.89 (0.91)	0.64 (0.37)	86.94	<0.0001
NC	3.71 (0.92)	2.77 (0.60)	25.39	0.3911

Questionnaire Development

- Bounded design implemented for several successive waves
- Provided independent estimates for a fixed reference period
- Varied in recall length and question order
- Collective effect of recall length and question order on estimates

11. **For each time period below, on how many days did this person go recreational saltwater fishing in <u>Maryland</u> from:**

a. The shore – include docks, bridges, causeways, beaches, banks or any other shore-based structure or area. Enter "0" if none.

☐☐ Days in March and April, 2013

☐☐ Days in Jan. and Feb., 2013

☐☐ Days in Sept., Oct., Nov., Dec., 2012

☐☐ Days in May, June, July, Aug. ,2012

Year	2012						2013												2014							
Month	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8

Survey Waves:

- Wave 4 - Wave 5 | Wave 6 - Wave 1 | Wave 2 | Wave 3
- Wave 5 - Wave 6 | Wave 1 - Wave 2 | Wave 3 | Wave 4
- Wave 6 - Wave 1 | Wave 2 - Wave 3 | Wave 4 | Wave 5
- Wave 1 - Wave 2 | Wave 3 - Wave 4 | Wave 5 | Wave 6
- Wave 2 - Wave 3 | Wave 4 - Wave 5 | Wave 6 | Wave 1
- Wave 3 - Wave 4 | Wave 5 - Wave 6 | Wave 1 | Wave 2
- Wave 4 - Wave 5 | Wave 6 - Wave 1 | Wave 2 | Wave 3

Questionnaire Development

State	Wave	Shore				Boat			
		2-mo recall % (SE)	4-mo recall % (SE)	Relative difference	p-value	2-mo recall % (SE)	4-mo recall % (SE)	Relative difference	p-value
FL	May/Jun	21.63 (1.11)	18.73 (1.32)	13.42	0.0929	11.6 (0.81)	11.04 (0.99)	4.84	0.6605
FL	Jul/Aug	20.47 (1.38)	21.86 (1.62)	-6.75	0.5161	10.98 (0.99)	14.50 (1.34)	-32.04	0.0345
FL	Sep/Oct	19.21 (1.55)	16.51 (1.33)	14.03	0.1874	12.04 (1.25)	9.71 (1.00)	19.40	0.1442
MA	May/Jun	10.83 (0.91)	9.94 (1.19)	8.23	0.5513	6.03 (0.65)	5.80 (0.94)	3.83	0.8402
MA	Jul/Aug	15.86 (1.50)	15.58 (1.62)	1.71	0.9024	9.39 (1.13)	11.07 (1.30)	-17.85	0.3295
MA	Sep/Oct	7.33 (1.17)	8.72 (1.23)	-19.05	0.4101	5.15 (0.89)	5.37 (1.03)	-4.24	0.8726
NY	May/Jun	8.86 (0.77)	7.35 (1.11)	17.10	0.2617	5.81 (0.64)	4.64 (0.88)	20.22	0.2802
NY	Jul/Aug	12.93 (1.46)	12.62 (1.51)	2.41	0.8823	8.25 (1.18)	10.87 (1.47)	-31.81	0.1639
NY	Sep/Oct	7.06 (1.13)	6.21 (0.89)	12.10	0.5528	6.70 (1.16)	4.93 (0.82)	26.43	0.2140
NC	May/Jun	11.5 (0.91)	11.32 (1.21)	1.54	0.9075	5.87 (0.61)	4.89 (0.71)	16.80	0.2926
NC	Jul/Aug	13.38 (1.28)	12.43 (1.21)	7.07	0.5907	5.93 (0.77)	7.82 (1.04)	-31.80	0.1436
NC	Sep/Oct	10.71 (1.19)	11.19 (1.45)	-4.50	0.7973	6.13 (0.93)	5.18 (0.90)	15.49	0.4627
NC	Nov/Dec	6.42 (1.09)	4.57 (1.12)	28.84	0.2354	2.69 (0.61)	2.86 (0.92)	-6.47	0.8750
NC	Jan/Feb	3.06 (1.08)	3.59 (1.30)	-17.28	0.7549	1.14 (0.26)	0.84 (0.18)	26.95	0.3279
NC	Mar/Apr	8.77 (1.88)	5.30 (0.83)	39.59	0.0913	3.20 (1.09)	2.36 (0.54)	26.30	0.4872
Overall		13.1 (0.34)	12.04 (0.36)	8.09	0.0338	7.53 (0.25)	7.57 (0.29)	-0.53	0.9054

- Estimates are generally larger when the recall period is shorter and the reference period is presented first in the question sequence

Questionnaire Development Key Points

- "Bounding" of the desired reference period against other time periods resulted in lower estimates than an unbounded design
- Estimates were higher when the length of the recall period was shorter and when the reference period was presented first in the question sequence
  - Forgetting trips (omission error) or reporting trips at the first opportunity (telescoping error)
  - Analysis can't disentangle effects
- Cognitive interviews suggest that anglers want to be identified as such and are eager to report fishing activity
- Questionnaire testing and cognitive interviews informed the current design of FES questionnaire, which includes a 2-month recall period followed by a 12-month bounding period

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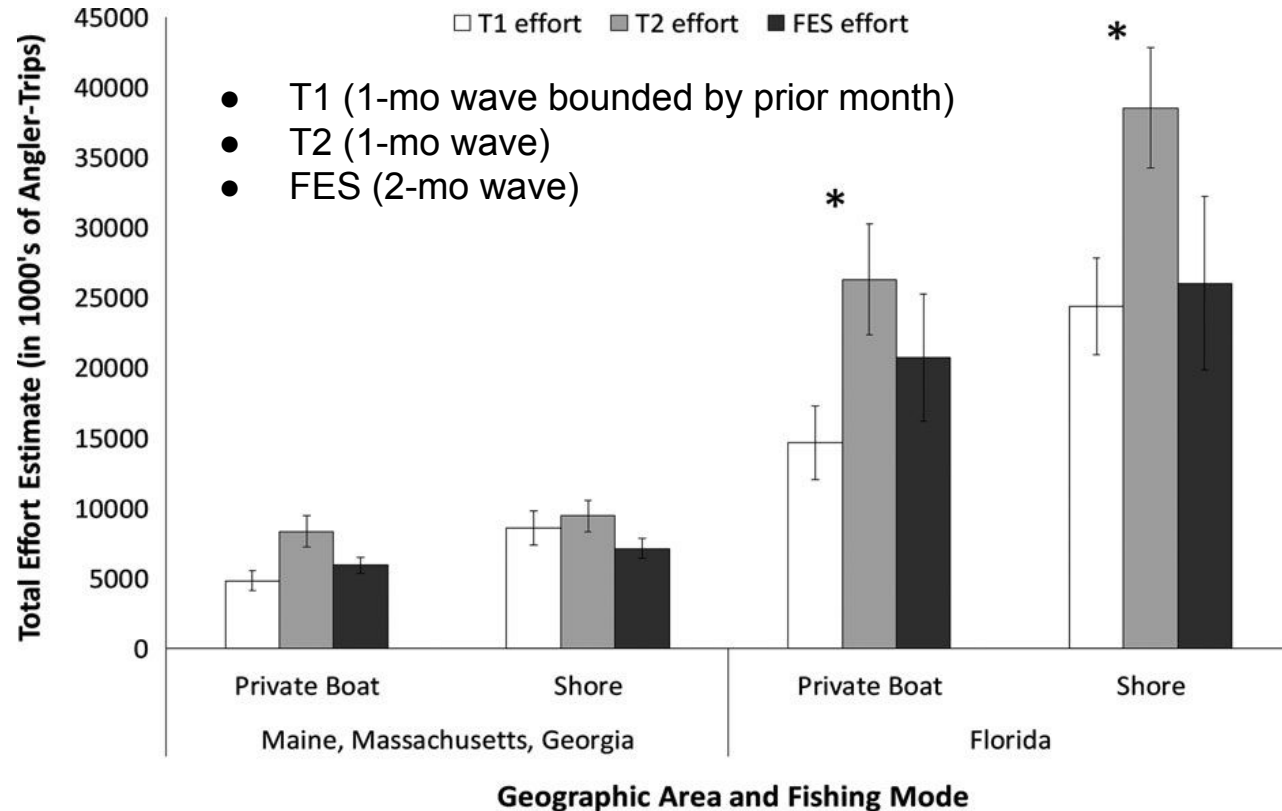
One-Month Wave Questionnaires

- Tested questionnaires with shorter reference periods
- Questionnaires differed in presentation of reference periods
- Additional evaluation of question order and recall period length

FES Questionnaire (Q's 15 and 16)

Please think only about recreational saltwater fishing in <Merged State>.

15 How many days did you go recreational saltwater fishing from the shore in <Merged State>? The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area.

☐ No shore recreational saltwater fishing in last 12 months → **Go to question 16**

☐☐ Number of days in July and August of 2015

☐☐ Total number of days in last 12 months

16 How many days did you go recreational saltwater fishing from a private or rental boat that returned to shore in <Merged State>? Do not include charter boats or commercial boats that have a captain or crew who help locate and catch fish.

☐ No private boat recreational saltwater fishing in last 12 months → **Go to Household Member 2**

☐☐ Number of days in July and August of 2015

☐☐ Total number of days in last 12 months

If you have more household members, continue to household member 2.

Treatment 1 Questionnaire (Q's 15 and 16)

Please think only about recreational saltwater fishing in <Merged State>.

15 How many days did you go recreational saltwater fishing from the SHORE in <Merged State>? *The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area. Do not include freshwater fishing.*

☐ Did not recreational saltwater fish from shore in last 12 months → **Go to question 16**

☐☐ Number of days shore fishing in Jun. of 2015

☐☐ Number of days shore fishing in Jul. of 2015

☐☐☐ Total number of days shore fishing in last 12 months, including Jun. and Jul.

16 How many days did you go recreational saltwater fishing from a private or rental BOAT that returned to shore in <Merged State>? *Do not include freshwater trips or trips where a paid captain or crew helped locate and catch fish.*

☐ Did not recreational saltwater fish from private boat in last 12 months.

☐☐ Number of days boat fishing in Jun. of 2015

☐☐ Number of days boat fishing in Jul. of 2015

☐☐☐ Total number of days boat fishing in last 12 months, including Jun. and Jul.

If you have more people in your household, continue to Household Member 2.

Treatment 2 Questionnaire (Q's 15 and 16)

Please think only about recreational saltwater fishing in <Merged State>.

15 How many days did you go recreational saltwater fishing from the SHORE in <Merged State>? *The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area. Do not include freshwater fishing.*

☐ Did not recreational saltwater fish from shore in last 12 months → **Go to question 16**

☐☐ Number of days shore fishing in Jul. of 2015

☐☐☐ Total number of days shore fishing in last 12 months, including Jul.

16 How many days did you go recreational saltwater fishing from a private or rental BOAT that returned to shore in <Merged State>? *Do not include freshwater trips or trips where a paid captain or crew helped locate and catch fish.*

☐ Did not recreational saltwater fish from private boat in last 12 months.

☐☐ Number of days boat fishing in Jul. of 2015

☐☐☐ Total number of days boat fishing in last 12 months, including Jul.

If you have more people in your household, continue to Household Member 2.

One-Month Wave Questionnaires

- FES estimates were larger than T2 estimates
- FES estimates similar to T1 estimates
- T1 estimates systematically lower than T2 estimates

- T1 (1-mo wave bounded by prior month)
- T2 (1-mo wave)
- FES (2-mo wave)

One-Month Wave Questionnaires

- Study implemented for several successive months
- Provided independent estimates for a fixed month
- Reference periods presented in chronological order
- Allowed us to evaluate effects of recall length and question order on estimates

15 How many days did you go recreational saltwater fishing from the SHORE in <Merged State>?

The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area. Do not include freshwater fishing.

☐ Did not recreational saltwater fish from shore in last 12 months ➔ *Go to question 16*

☐☐ Number of days shore fishing in Jul. of 2015

☐☐ Number of days shore fishing in Aug. of 2015

☐☐ Total number of days shore fishing in last 12 months, including Jul. and Aug.

Month	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	1	2							
		1	2						
			1	2					
				1	2				
					1	2			
						1	2		

(Row label: Question Order)

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One-Month Wave Questionnaires

- Longer recall period (presented first) resulted in larger estimates
- Question order is primary effect rather than the length of recall period
- Suggests telescoping is predominant form of error

Measure	Month 1 % (SE)	Month 2 % (SE)	Relative Difference	p-value
Shore prevalence				
Overall	9.26 (0.69)	5.97 (0.53)	35.53	0.0002
July	7.82 (1.23)	7.25 (1.29)	7.30	0.7508
August	12.05 (1.77)	6.16 (1.08)	49.68	0.0041
September	10.66 (1.86)	7.0 (1.30)	34.33	0.1121
October	7.01 (1.36)	4.97 (1.10)	29.15	0.2494
November	8.75 (1.44)	4.6 (1.11)	47.48	0.0246
Boat prevalence				
Overall	6.35 (0.54)	3.85 (0.40)	39.37	0.0003
July	6.46 (1.10)	3.44 (0.78)	46.73	0.0275
August	7.62 (1.30)	4.43 (0.88)	41.92	0.0499
September	6.06 (1.28)	4.2 (0.96)	30.69	0.2521
October	4.67 (1.13)	3.51 (0.90)	24.89	0.4242
November	6.95 (1.24)	3.66 (0.95)	47.39	0.0386

One-Month Waves Key Points

- Bounding reduces estimates and is likely more effective at reducing telescoping error when bounding questions precede reference period
- 2-month FES reference period may mitigate some telescoping error relative to shorter reference periods
- Estimates were higher when the recall period was longer and when the reference period was presented first in the question order
  - Suggests that question order has a greater effect than recall length
  - Telescoping error likely to be the predominant source of measurement error rather than omission error

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Question Order Effects

FES: SH:PR/2:12

15 How many days did you go recreational <u>saltwater</u> fishing from the SHORE in <u>North Carolina</u>?

The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area. Do not include freshwater fishing.

☐ Did not recreational saltwater fish from shore in last 12 months → *Go to question 16*

▢▢▢ Number of days saltwater shore fishing in January and February of 2018

▢▢▢ Number of days saltwater shore fishing in last 12 months, including January and February

16 How many days did you go recreational <u>saltwater</u> fishing from a private or rental BOAT that returned to shore in <u>North Carolina</u>?

Do not include freshwater trips or trips where a paid captain or crew helped locate and catch fish.

☐ Did not recreational saltwater fish from private boat in last 12 months

▢▢▢ Number of days saltwater boat fishing in January and February of 2018

▢▢▢ Number of days saltwater boat fishing in last 12 months, including January and February

EXP1: SH:PR/12:2

15 How many days did you go recreational <u>saltwater</u> fishing from the SHORE in <u><<statefull>></u>?

The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area. Do not include freshwater fishing.

☐ Did not recreational saltwater fish from shore in last 12 months → *Go to question 16*

▢▢▢ Number of days saltwater shore fishing in last 12 months

▢▢▢ Number of days saltwater shore fishing in <<refperiod2>>

16 How many days did you go recreational <u>saltwater</u> fishing from a private or rental BOAT that returned to shore in <u><<statefull>></u>?

Do not include freshwater trips or trips where a paid captain or crew helped locate and catch fish.

☐ Did not recreational saltwater fish from private boat in last 12 months

▢▢▢ Number of days saltwater boat fishing in last 12 months

▢▢▢ Number of days saltwater boat fishing in <<refperiod2>>

EXP2: PR:SH/2:12

15 How many days did this person go recreational <u>saltwater</u> fishing from a private or rental BOAT that returned to shore in <u>North Carolina</u>?

Do not include freshwater trips or trips where a paid captain or crew helped locate and catch fish.

☐ Did not recreational saltwater fish from private boat in last 12 months → *Go to question 16*

▢▢▢ Number of days saltwater boat fishing in November and December of 2019

▢▢▢ Number of days saltwater boat fishing in last 12 months, including November and December

16 How many days did this person go recreational <u>saltwater</u> fishing from the SHORE in <u>North Carolina</u>?

The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area. Do not include freshwater fishing.

☐ Did not recreational saltwater fish from shore in last 12 months

▢▢▢ Number of days saltwater shore fishing in November and December of 2019

▢▢▢ Number of days saltwater shore fishing in last 12 months, including November and December

EXP3: PR:SH/12:2

15 How many days did you go recreational <u>saltwater</u> fishing from a private or rental BOAT that returned to shore in <u>North Carolina</u>?

Do not include freshwater trips or trips where a paid captain or crew helped locate and catch fish.

☐ Did not recreational saltwater fish from private boat in last 12 months → *Go to question 16*

▢▢▢ Number of days saltwater boat fishing in last 12 months

▢▢▢ Number of days saltwater boat fishing in November and December of 2019

16 How many days did you go recreational <u>saltwater</u> fishing from the SHORE in <u>North Carolina</u>?

The shore includes docks, bridges, causeways, beaches, banks, or any other shore-based place or area. Do not include freshwater fishing.

☐ Did not recreational saltwater fish from shore in last 12 months

▢▢▢ Number of days saltwater shore fishing in last 12 months

▢▢▢ Number of days saltwater shore fishing in November and December of 2019

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Question Order Effects

	SH:PR/2:12 (FES) % (SE)	SH:PR/12:2 % (SE)	PR:SH/2:12 % (SE)	PR:SH/12:2 % (SE)
Shore Prevalence	6.01 (0.20)	4.61 (0.61)	4.82 (0.28)	3.95 (0.27)
Boat Prevalence	4.61 (0.18)	3.37 (0.23)	5.19 (0.31)	3.16 (0.21)

- Estimates were highest for the mode that was presented first and the 2-month question preceded the 12-month question
- Within the 2-month/12-month order, estimates were significantly lower when the mode was presented second
- Mode order was not significant when 12-month question preceded 2-month question

Question Order Change Key Points

- The order of the 2-month/12-month questions has a stronger effect than the mode order
- Presenting the 12-month trip question prior to the 2-month trip question resulted in lower estimates
- Asking the 12-month question before the 2-month question appears to reduce telescoping error, resulting in more accurate estimates than the current FES design.

Overall Key Points

- Telescoping error is likely the predominant form of measurement error in the FES
- "Bounding" is likely to reduce telescoping error
- Bounding is most effective when the bounding period precedes the reference period
- Implementing a more effective questionnaire design will likely result in lower estimates

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Why do we think pilot study estimates are more accurate?

- Anglers want to report fishing activity
- Approach is consistent with studies examining measurement error for other data collection modes
- Fewer illogical responses

Why didn't we implement the new questionnaire in the first place?

- FES questionnaire is based upon a standard practice of asking easier questions first and then proceeding to more difficult questions

- FES questionnaire was informed by cognitive interviews and tested through a series of pilot studies

- The design was informed by survey methodologists and peer reviewed by NASEM and ASA

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Follow-up Study & Next Steps

- Revised design administered concurrently with current FES over full course of 2024 (**larger sample size over longer duration**).
- New study design is informed by results of two previous pilot studies (one month waves, question order) and additional cognitive interviewing.
- Revised design includes **both questionnaire changes and increasing the administration of the survey** from every two months to monthly.
  - Study will determine **combined effects,** which allows for a more efficient transition/calibration process.
  - **Monthly sampling** is a priority of our partners and will produce **more frequent estimates and a shorter respondent recall** period that may also improve reporting error.

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Follow-up Study & Next Steps

- Existing FES **calibration will be updated** to account for new design changes

- Calibration update work has started and will continue as needed into 2024 and 2025 pending results from the 2024 follow-up study

- Full implementation of an improved FES design would occur **no earlier than 2026** and would be dependent on
  - Successful completion of the follow-up study and calibration updates
  - Favorable technical peer review and updated FES Transition Plan developed in coordination with partners on the MRIP Transition Team
  - Fully calibrated historic time series of catch and effort estimates

Questions?