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APAIS Calibration and Calibration Impacts on Effort Time Series

Standing, Reef Fish, Mackerel, Ecosystem, & Socioeconomic MRIP SSC Meeting
July 8-9, 2020

Presentation Outline

I. APAIS Calibration
   i. Weighting Adjustment Approach
   ii. 2004-2013 Time Series
   iii. 1981-2004 Time Series
   iv. Minimizing Risk of Over-Adjustment

II. Calibration Impacts on Effort Time Series

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Background

- APAIS calibration methods peer reviewed in 2018

Access Point Angler Intercept Survey Calibration Workshop
March 20-22, 2018 Silver Spring, MD

- Reviewers identified through Center of Independent Experts (CIE), Regional Council SSC's and Atlantic States Marine Fisheries Commission
- Panel endorsed the method
- Calibration completed in July 2018

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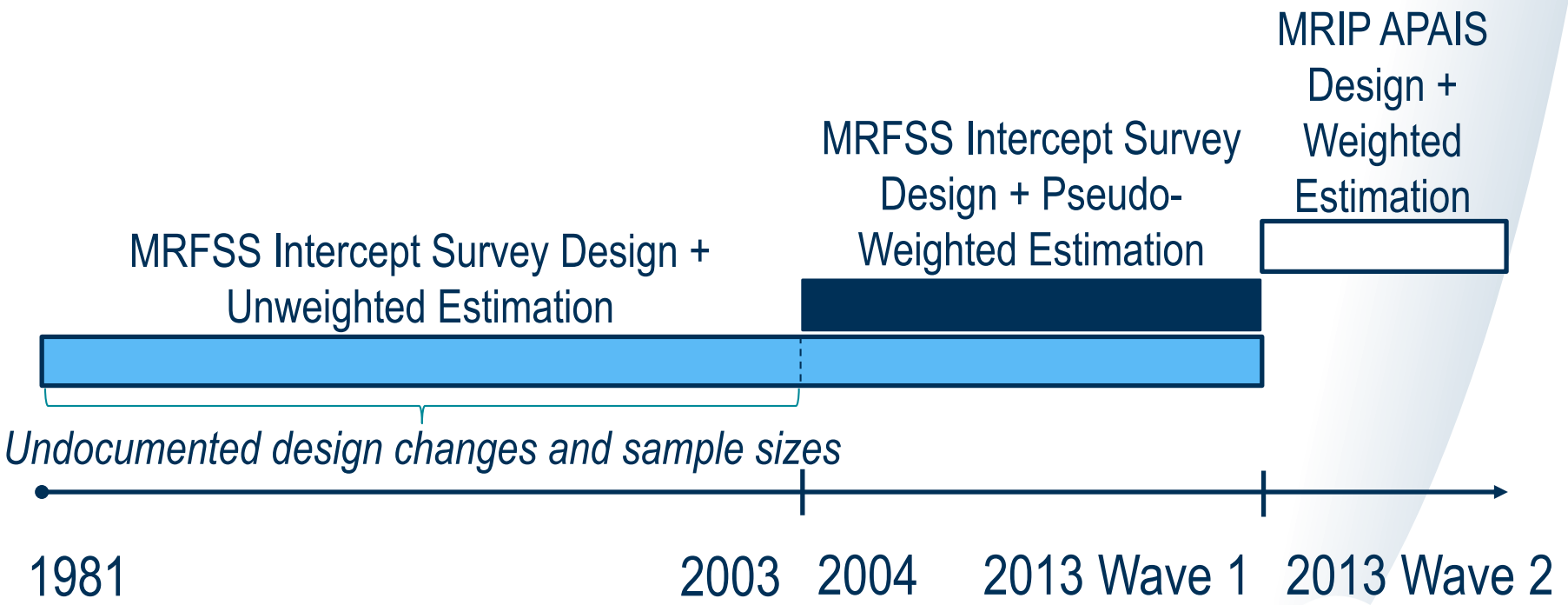
APAIS Calibration: Challenges



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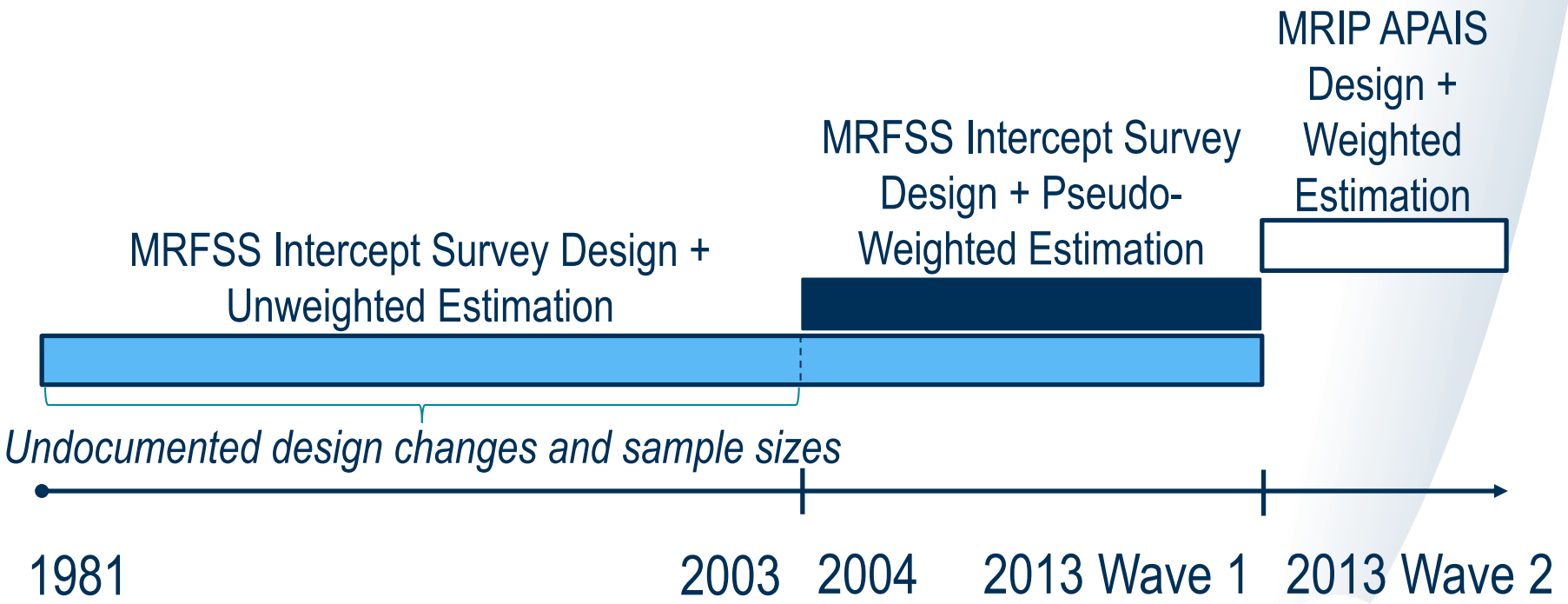
APAIS Calibration: Challenges

- No large-scale benchmarking was conducted
  - Too high of an expense and unreasonable reporting burden on anglers



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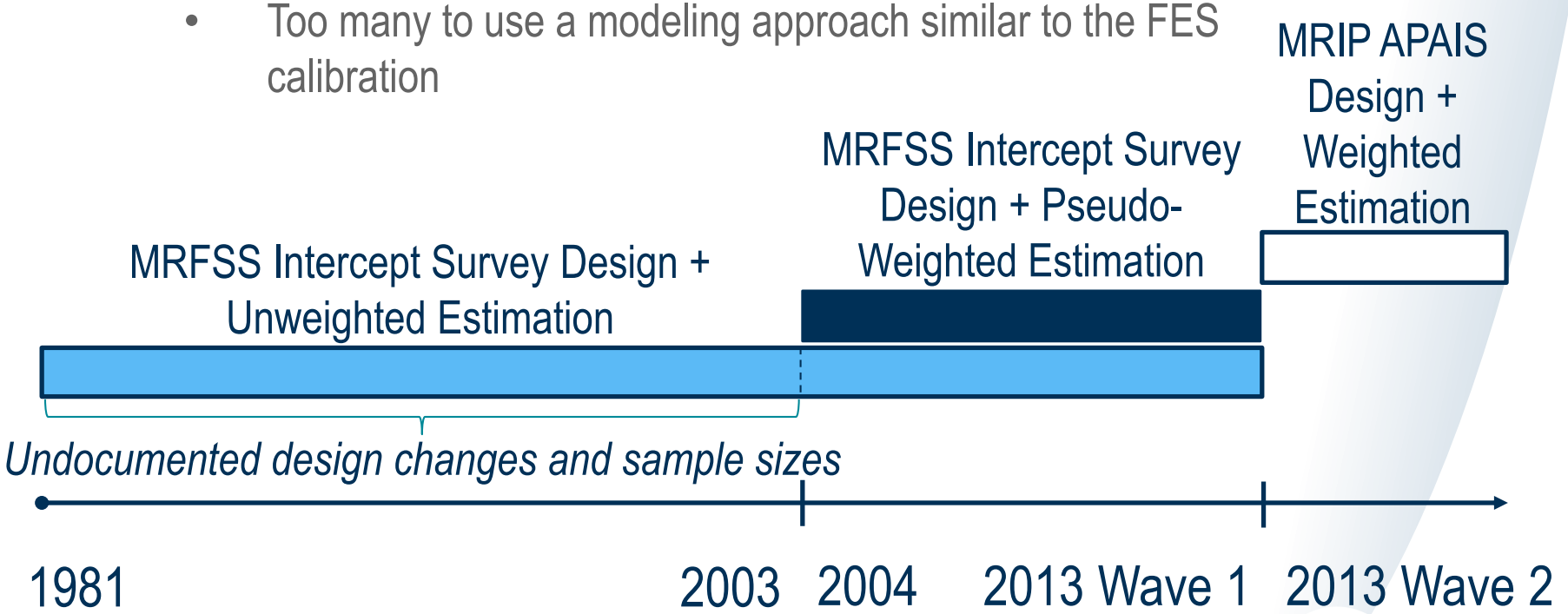
APAIS Calibration: Challenges

- No large-scale benchmarking was conducted
  - Too high of an expense and unreasonable reporting burden on anglers
- Hundreds of catch estimates by species and fishing mode needing to be calibrated
  - Too many to use a modeling approach similar to the FES calibration



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General Catch Rate Calibration Approach

- Raking ratio adjustment - widely used survey calibration approach (Deming and Stephan 1940)
    - Consists of sequential adjustments to sample weights, based on known population characteristics, until weights converge (stop changing)

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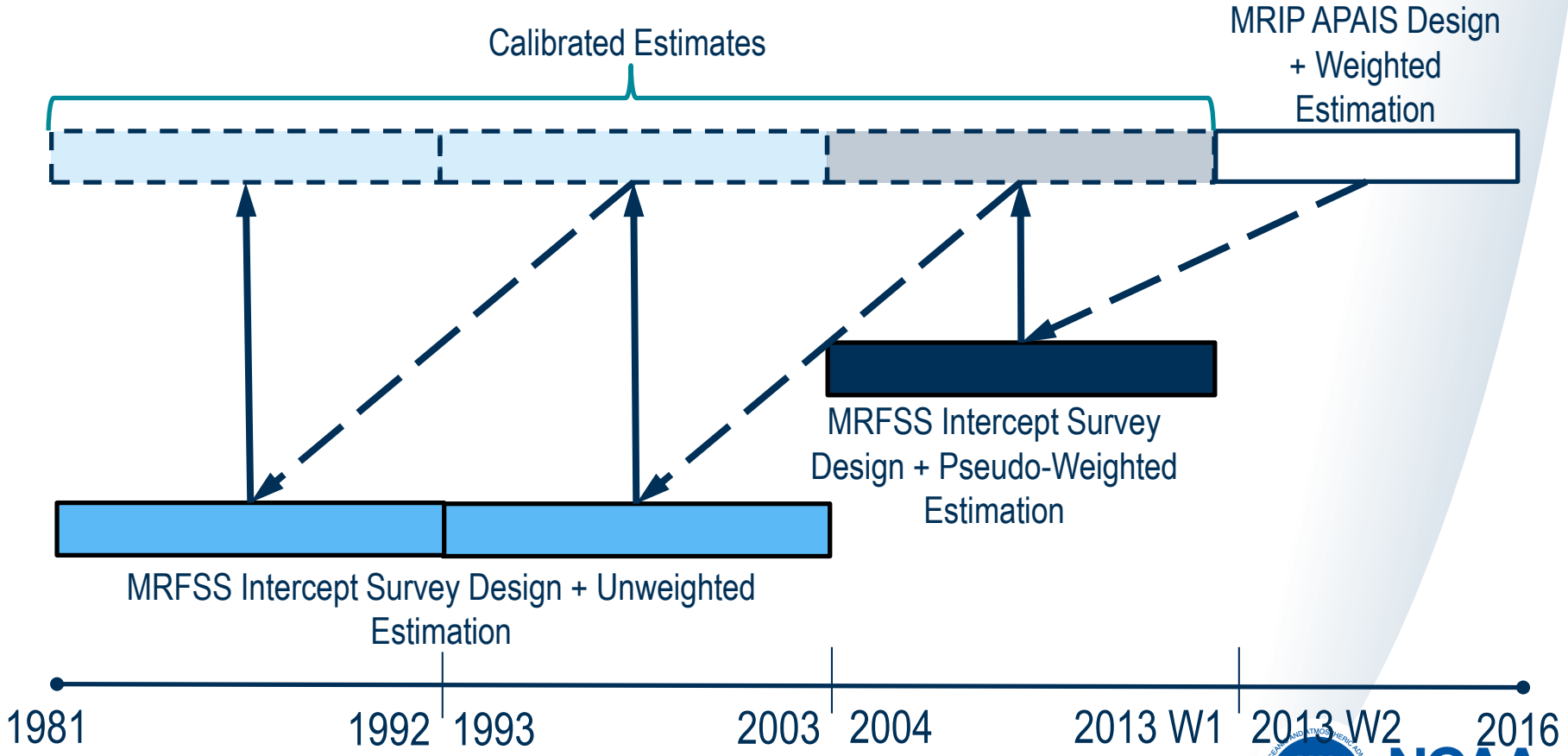
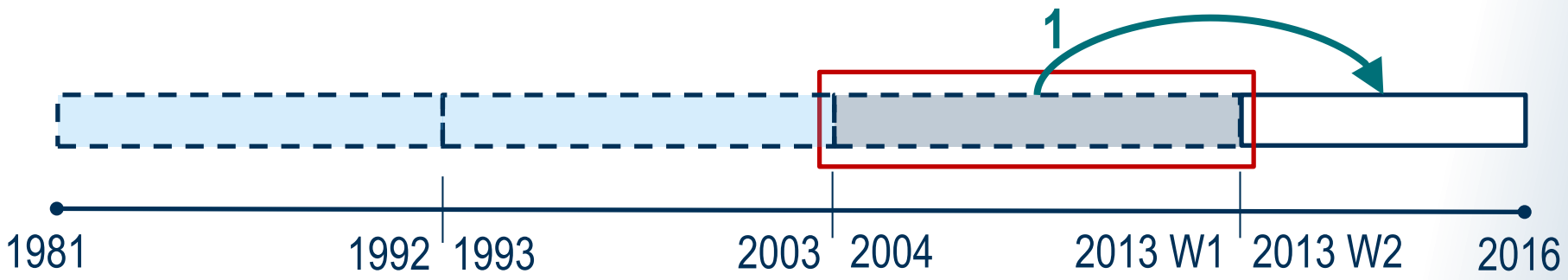
Raking Ratio (Sample Weight) Adjustment Method

- Raking ratio adjustments were applied to sample weights in 10 year time periods across broad domains based on trip characteristics driving differences between MRFSS and APAIS



2004-2013 Sample Weight Adjustments



Domains used as adjustment cells: State, wave, fishing mode and

- **Area Fished** (inshore, nearshore, offshore)
- **Household Status** (Coastal or Non-Coastal)
- **For-hire frame status** (vessels on the for-hire sample frame or not)
- **Sub-State Region**

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Raking Ratio Adjustment: Starting Calculation

Adjusted sample weight of angler trip *j*

$$w_j^* = R_d w_j$$

Initial sample weight of angler trip *j*

Average domain estimate for reference period (2013-2016)

$$\frac{\hat{N}_{D,new}}{\hat{N}_{D,old}}$$

Average domain estimate for the adjustment period (2004-2013)

The component annual estimates for $\hat{N}_{D,new}$ and $\hat{N}_{D,old}$ are calculated as the sum of the sample weights in domain D

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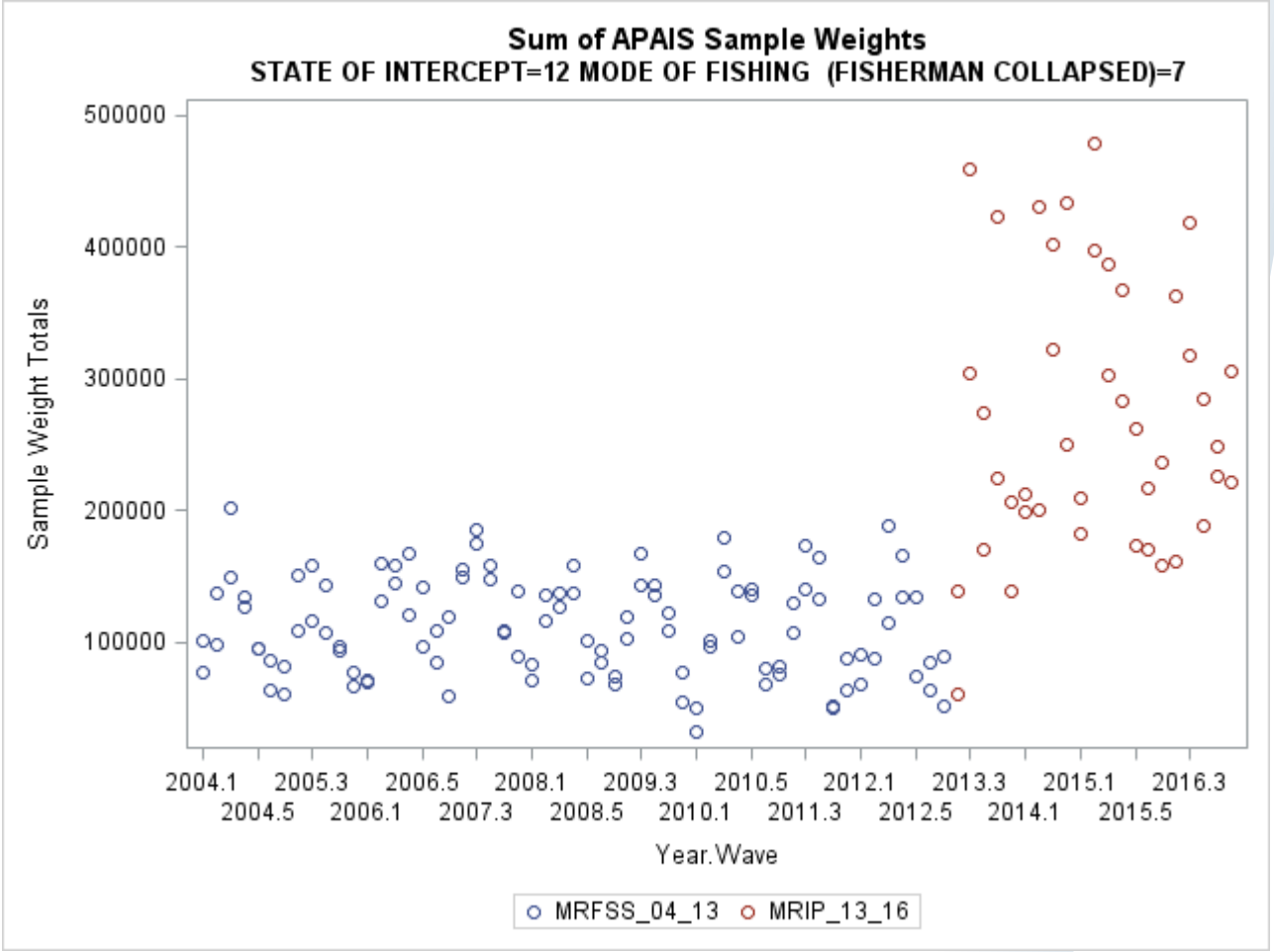
APAIS Sample Weight Totals

Florida
Private Boat Mode



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Raking Algorithm

$$w_j^{(t+1)} = R_d w_j^{(t)}$$

R_d = ratio of the average domain estimates for reference period (newer section of time series) to the adjustment period (older section of time series)

$w_j^{(t)}$ = initial sample weight of angler trip *j*

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Raking Algorithm

$$w_j^{(t+1)} = R_d w_j^{(t)}$$

$$\downarrow$$

$$w_j^{(t+2)} = R_d w_j^{(t+1)}$$

R_d = ratio of the average domain estimates for reference period (newer section of time series) to the adjustment period (older section of time series)

$w_j^{(t)}$ = initial sample weight of angler trip *j*

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Raking Algorithm

$$w_j^{(t+1)} = R_d w_j^{(t)}$$

$$\downarrow$$

$$w_j^{(t+2)} = R_d w_j^{(t+1)}$$

$$\downarrow$$

$$w_j^{(t+3)} = R_d w_j^{(t+2)}$$

R_d = ratio of the average domain estimates for reference period (newer section of time series) to the adjustment period (older section of time series)

$w_j^{(t)}$ = initial sample weight of angler trip *j*

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Raking Algorithm

$$w_j^{(t+1)} = R_d w_j^{(t)}$$

$$\downarrow$$

$$w_j^{(t+2)} = R_d w_j^{(t+1)}$$

$$\downarrow$$

$$w_j^{(t+3)} = R_d w_j^{(t+2)}$$

$$\downarrow$$

$$w_j^{(t+4)} = R_d w_j^{(t+3)}$$

R_d = ratio of the average domain estimates for reference period (newer section of time series) to the adjustment period (older section of time series)

$w_j^{(t)}$ = initial sample weight of angler trip *j*

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Raking Algorithm

$$w_j^{(t+1)} = R_d w_j^{(t)}$$

$$w_j^{(t+2)} = R_d w_j^{(t+1)}$$

$$w_j^{(t+3)} = R_d w_j^{(t+2)}$$

$$w_j^{(t+4)} = R_d w_j^{(t+3)}$$

$$\dots$$

$$w_j^{(t+n)} = R_d w_j^{(t+n)}$$

R_d = ratio of the average domain estimates for reference period (newer section of time series) to the adjustment period (older section of time series)

$w_j^{(t)}$ = initial sample weight of angler trip *j*

Stops running when final weight = iterated weight

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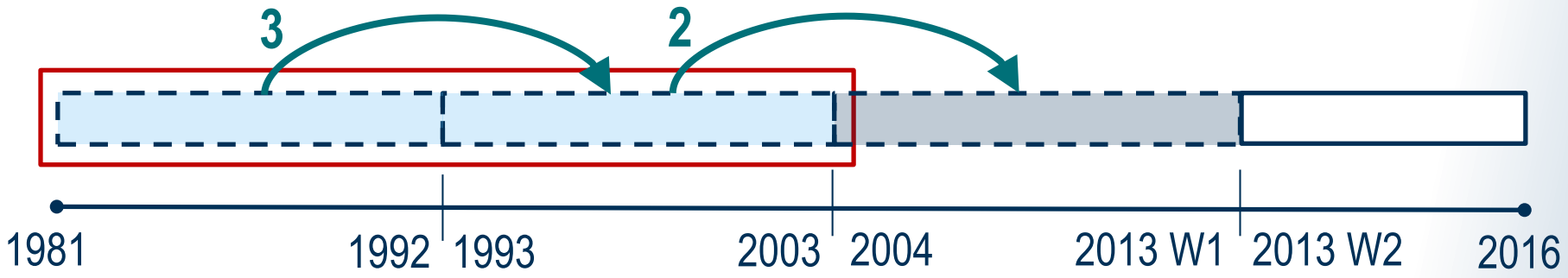
1981-2003 Sample Weight Adjustments



Domains used as adjustment cells: State, wave, fishing mode and

- **Area Fished** (inshore, nearshore, offshore)
- **Household Status** (Coastal or Non-Coastal)
- **For-hire frame status** (vessels on the for-hire sample frame or not)
- **Sub-State Region**
- **Kind of day** (weekday or weekend)
- **Site activity class** (high or low activity - based on annual counts of intercepts by fishing mode)

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1981-2003 Sample Weight Adjustments

Unknown/needed to be estimated since estimates were not weighted pre-2004

Adjusted sample weight of angler trip *j*

$$w_j^* = R_d w_j$$

Initial sample weight of angler trip *j*

$$R_d = \frac{\hat{N}_{D,new}}{\hat{N}_{D,old}}$$

Average domain estimate for reference period (either 2004-2013, or 1992-2003)

Average domain estimate for the adjustment period (either 1992-2003, or 1981-1991)

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1981-2003 Sample Weight Adjustments

Maximum count of site-days in domain *D* across all year in the time series interval (either 1981-1992, or 1993-2003)

Total count of site-days in domain *D* in year *YYYY*

$$w_j = \frac{C_{D,max}}{C_{D,YYYY}}$$

Estimated pre-2004 sample weights were meant to capture the relative changes in site-day sampling intensity over time.

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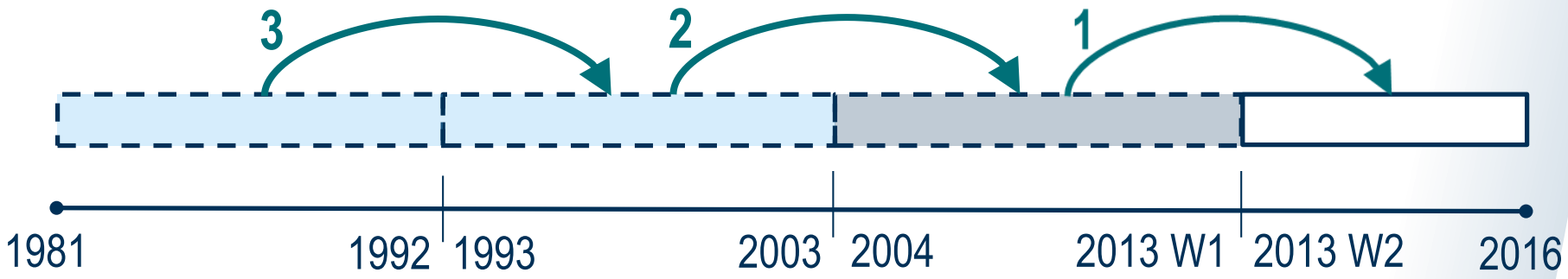
Possible limitations of applying weighting adjustments in 10-year increments



Assumes that the differences between reference periods and adjustment periods are ONLY attributed to changes in survey design…

If there were actual changes in the fishery over time (within these 10-year increments) then adjusting in this manner would mask those changes.

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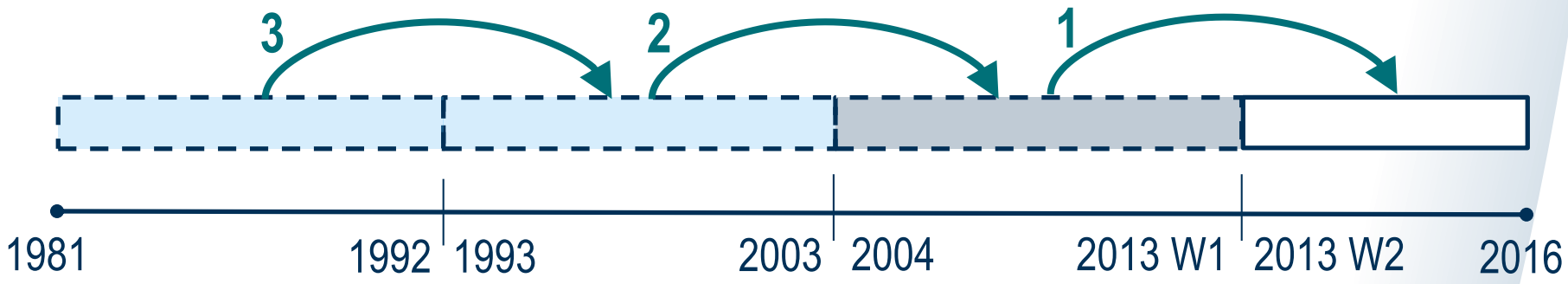
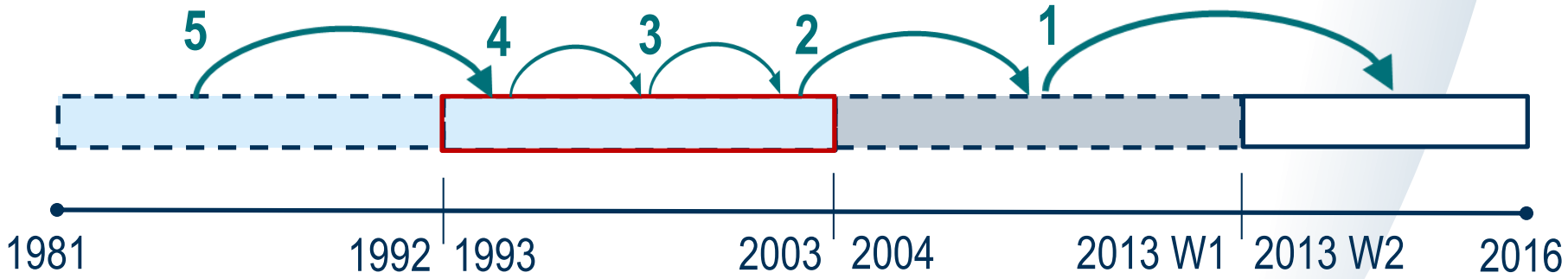
Reducing the risk of over-adjustment when real changes in a fishery could have occurred

Sequential Adjustments for a Normal Domain:



Adjustments for a Domain with a trend detected between 1993-2003:



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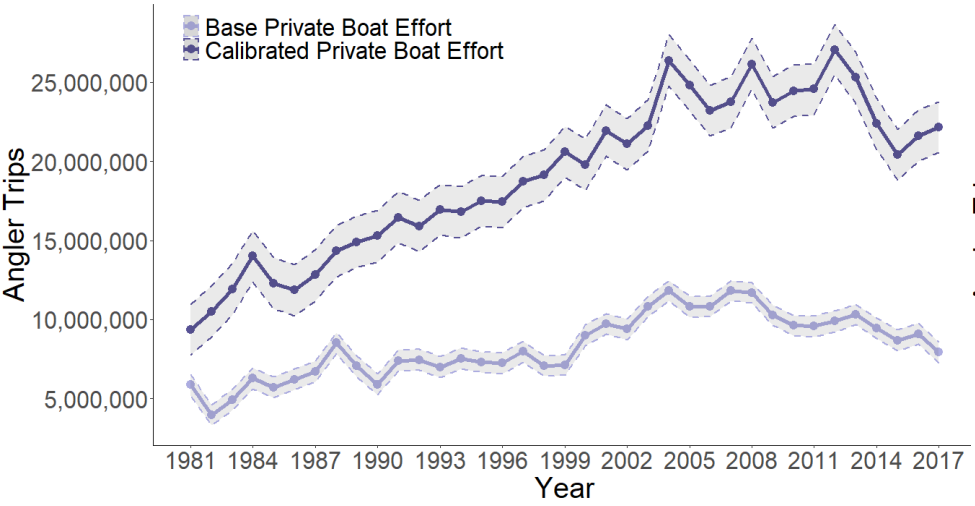
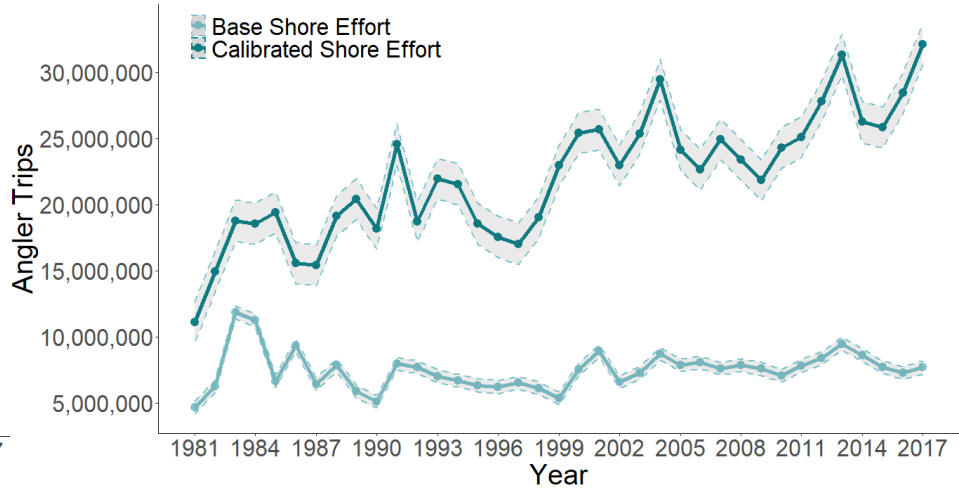
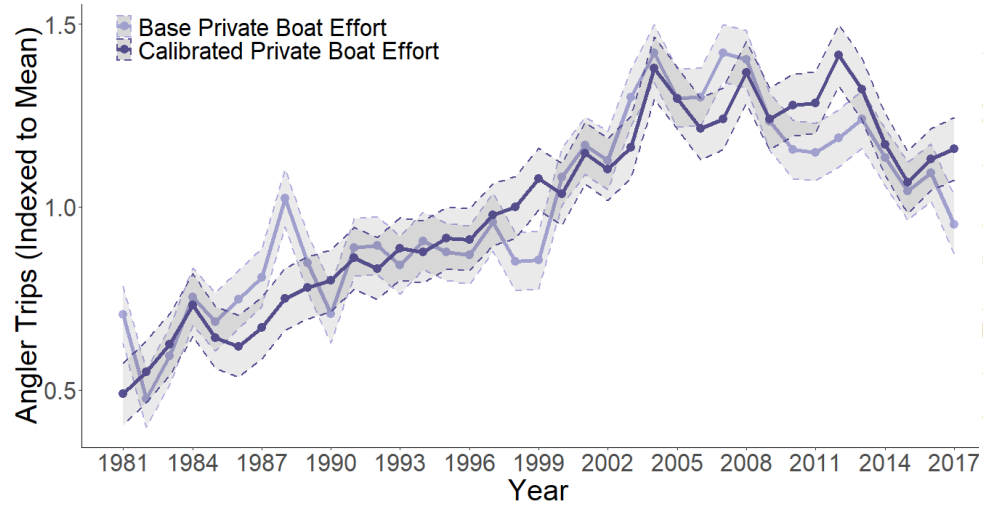
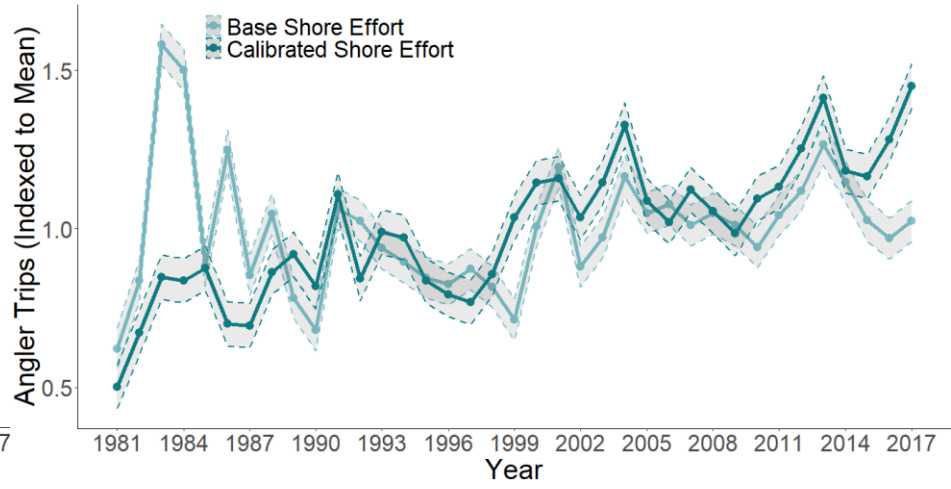
Effects on Effort Time Series (FES+APAIS Calibration)









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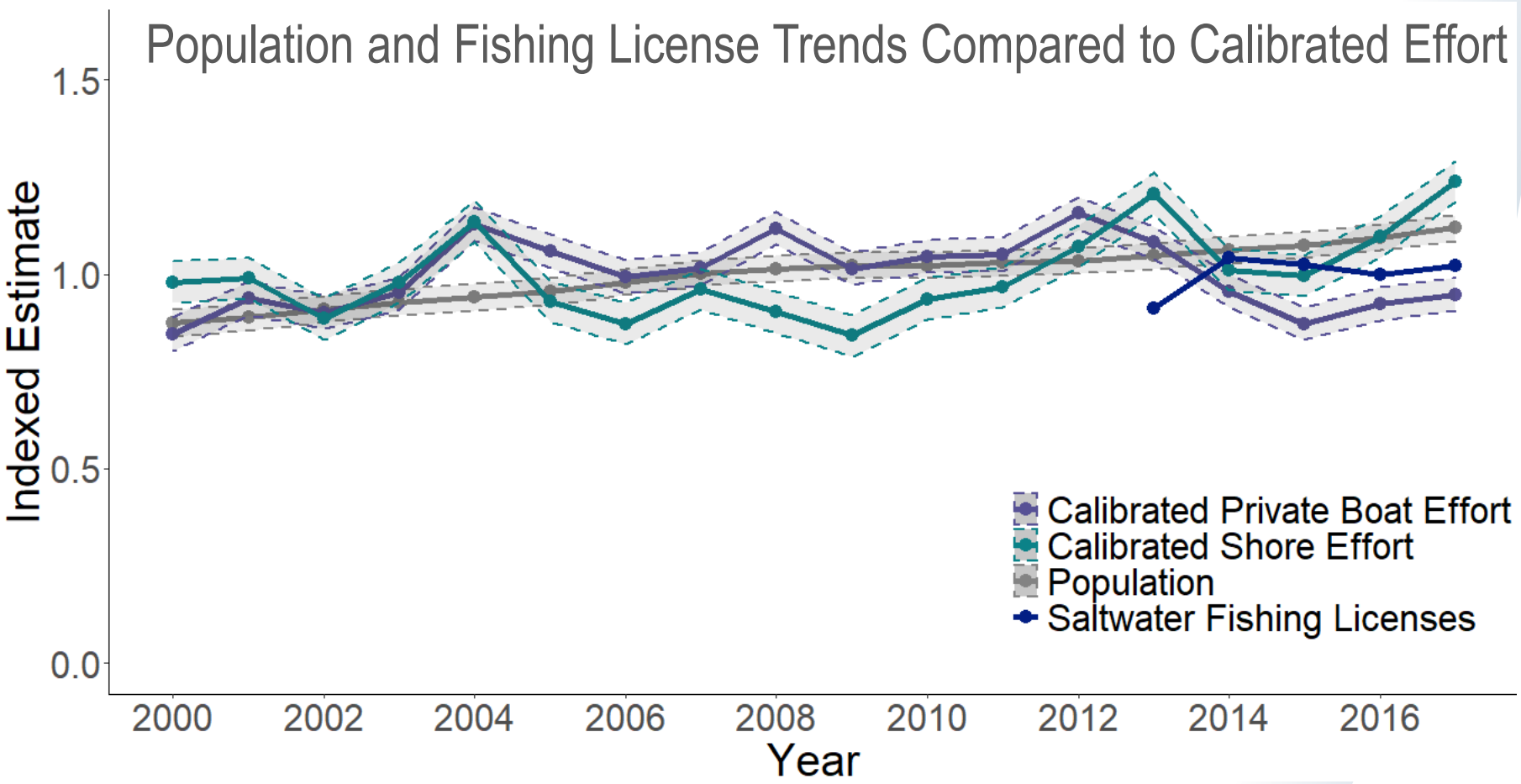
Effects on Effort Time Series (FES+APAIS Calibration)



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Summary

- The APAIS calibration used well-established statistical techniques.
- The catch time series was calibrated in segments to prevent over-adjustment.
- Additional steps were taken to minimize the risk of masking real trends in the fishery during the calibration process.
- Calibration (FES+APAIS) increased the base effort time series by 2.7 times on average.
- The base and calibrated effort time series exhibit similar trends over time.

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