Effects of survey changes on MRIP estimates

With bluefish case study

Mid-Atlantic Fishery Management Council
Scientific and Statistical Committee Meeting
March 11, 2020
Baltimore, MD

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Presentation Outline

I. **Explaining Differences Between FES and CHTS**

II. Survey Design and Estimation Methods

III. Calibration Methods

IV. Case Study: Bluefish

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CHTS

- Random-digit dial survey of households in coastal counties.
- Asks initial respondent a series of questions about household-level fishing activity.
- Contacts households with no prior notice and expects immediate response.
- Requires trip-level reporting.
- Suffered from declining rates of coverage and response.

FES

- Residential mail survey of addresses in coastal states.
- Gives respondents time to consider request, determine who should respond, and consult others.
- Includes cues that support cognitive processing and recall.
- Requires summary reports.
- Designed to maximize coverage and response rates.

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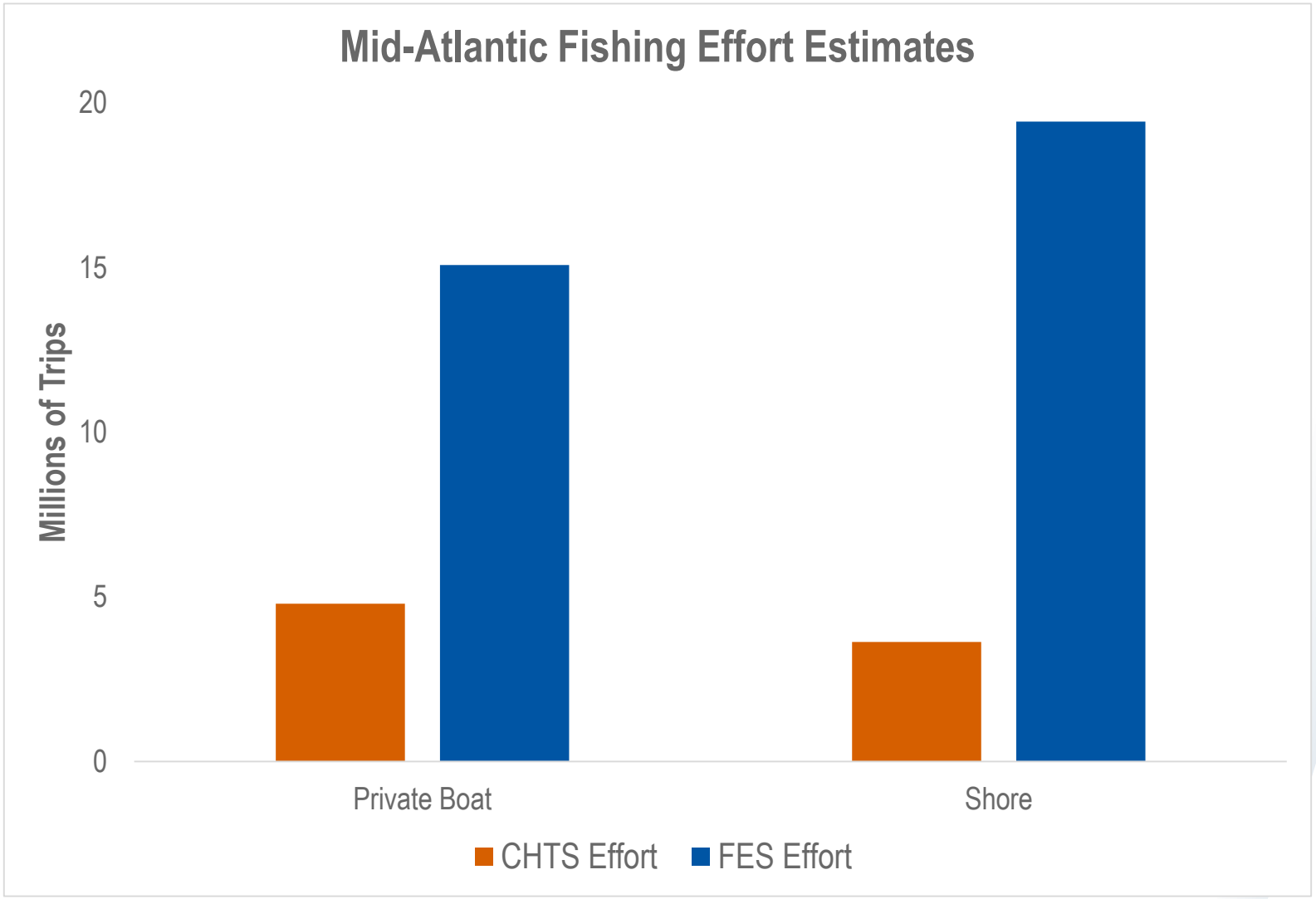

Estimates produced by the Fishing Effort Survey are much larger than estimates produced by the Coastal Household Telephone Survey.

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The Degradation of the CHTS

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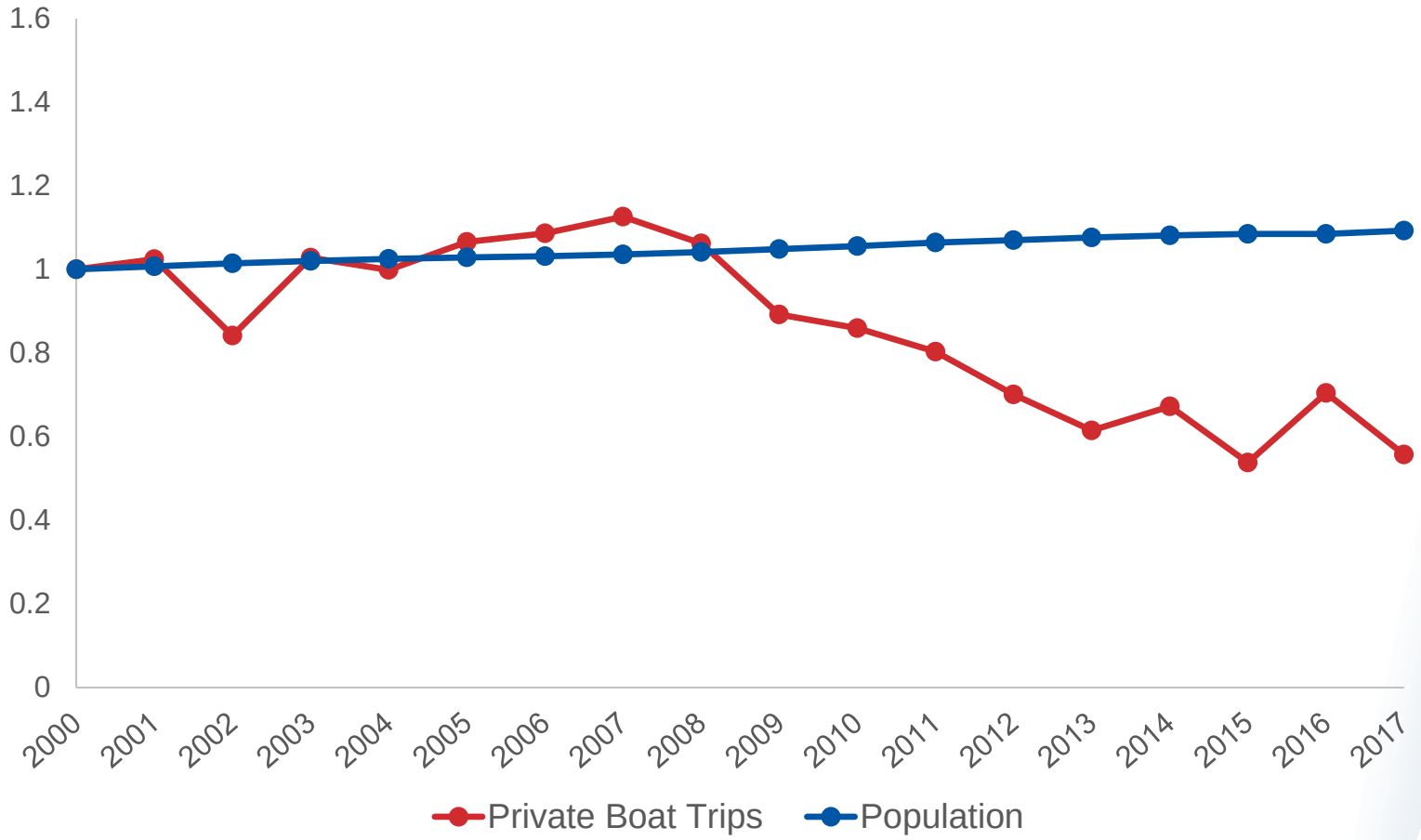
CHTS Effort Estimates

Private Boat Effort in Mid-Atlantic States



Does the decline in CHTS estimates reflect reality? Or is it an artifact of the survey's degrading design?

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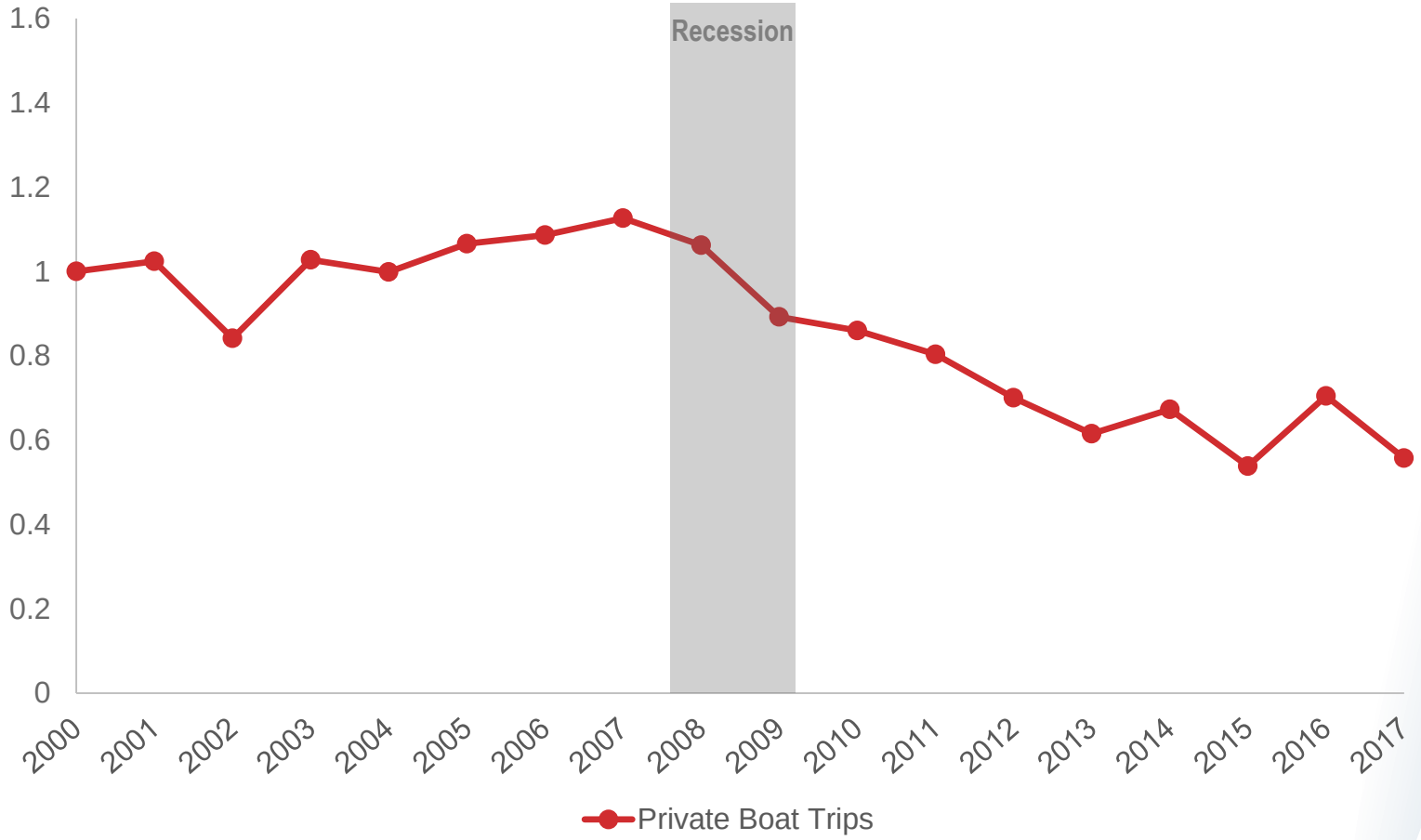
CHTS Effort Estimates
Private Boat Effort in Mid-Atlantic States



Some have attributed this decline in fishing effort to the recession. But economic conditions—and fishing activity—have recovered.

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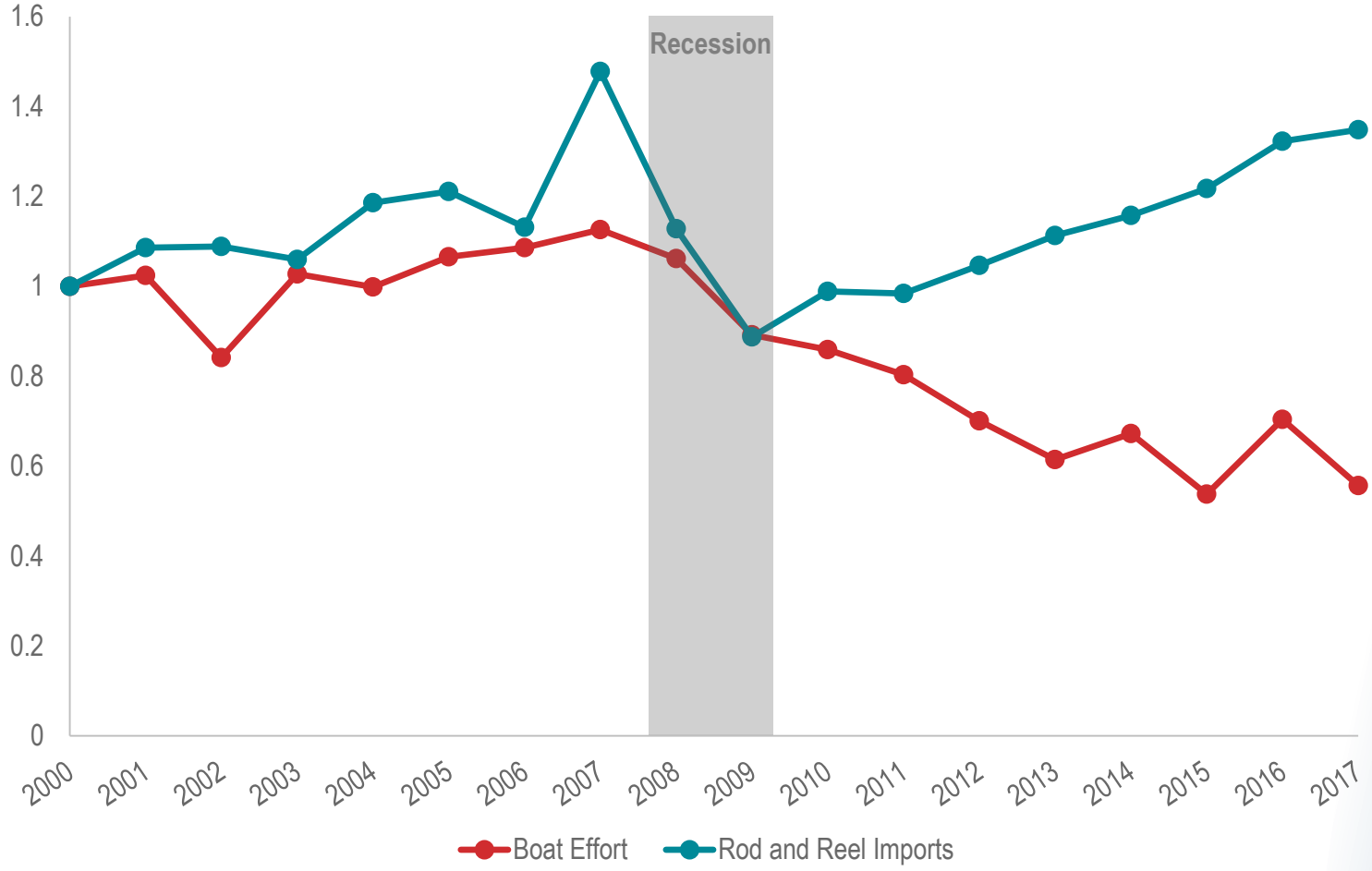
CHTS Effort Estimates

Private Boat Effort in Mid-Atlantic States



Rod and reel imports declined during the recession, but have since recovered.

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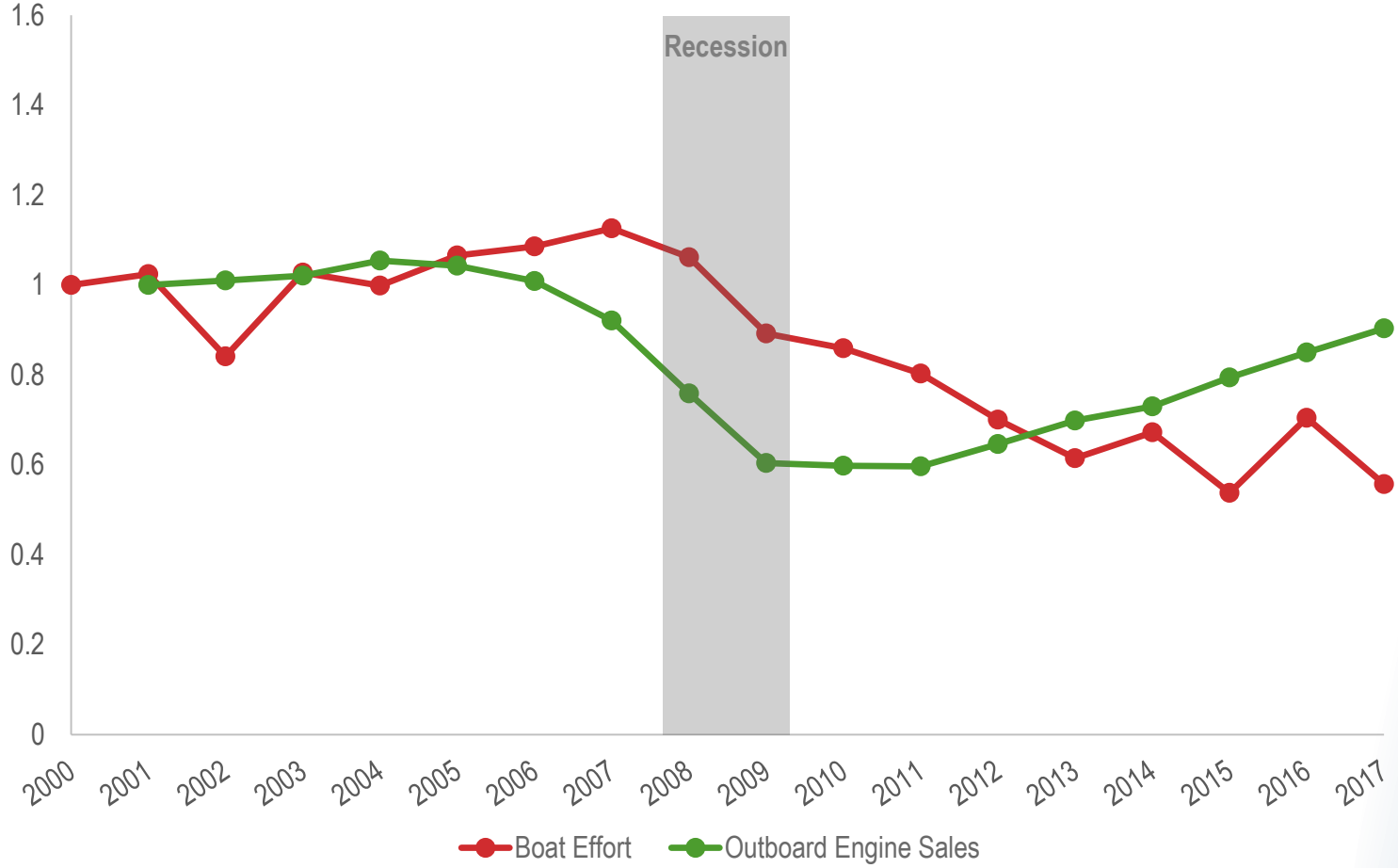
CHTS Effort Estimates

Private Boat Effort in Mid-Atlantic States



Outboard engine sales declined during the recession, but have since recovered.

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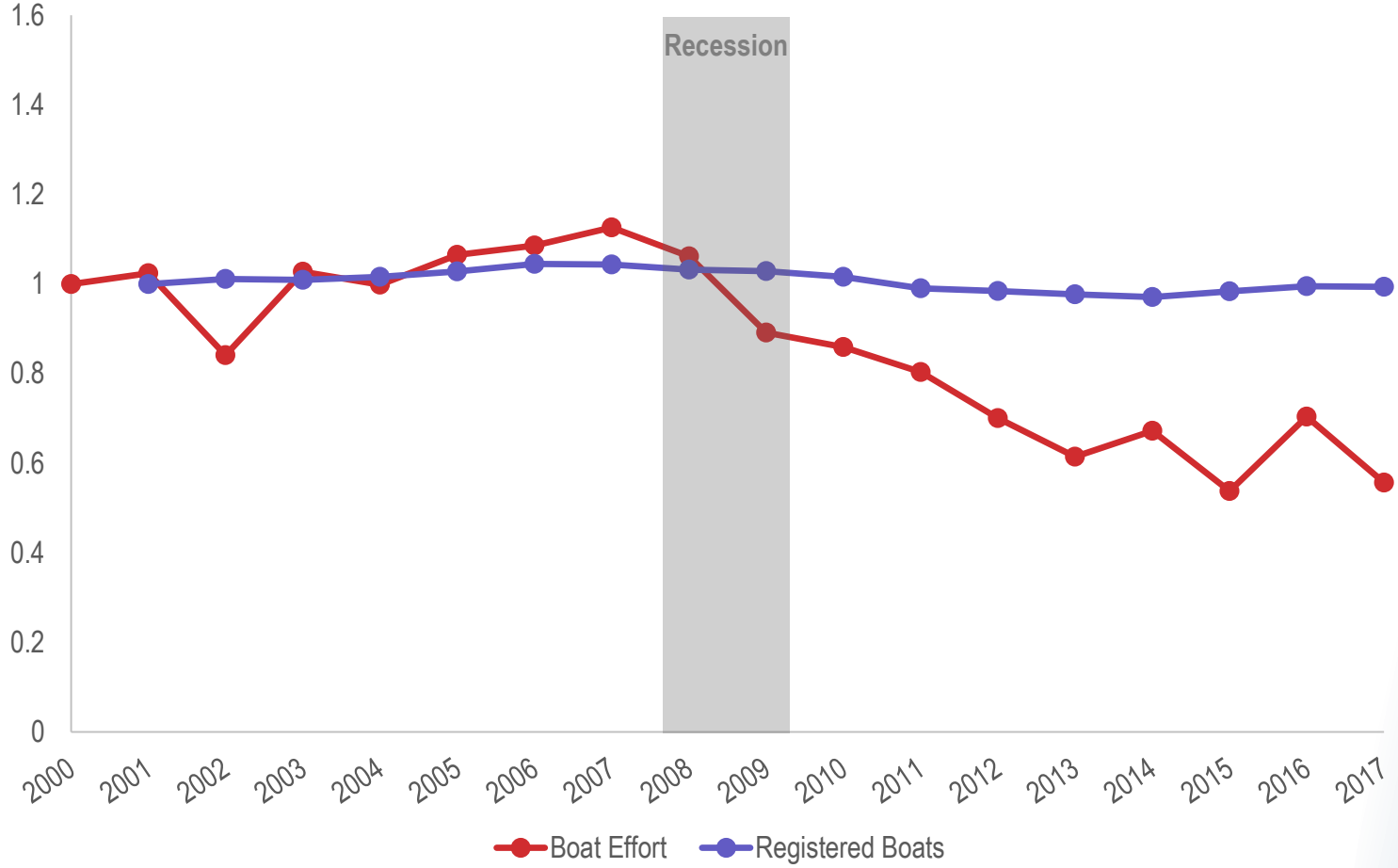
CHTS Effort Estimates

Private Boat Effort in Mid-Atlantic States



The number of registered boats in mid-Atlantic states has remained fairly consistent over time.

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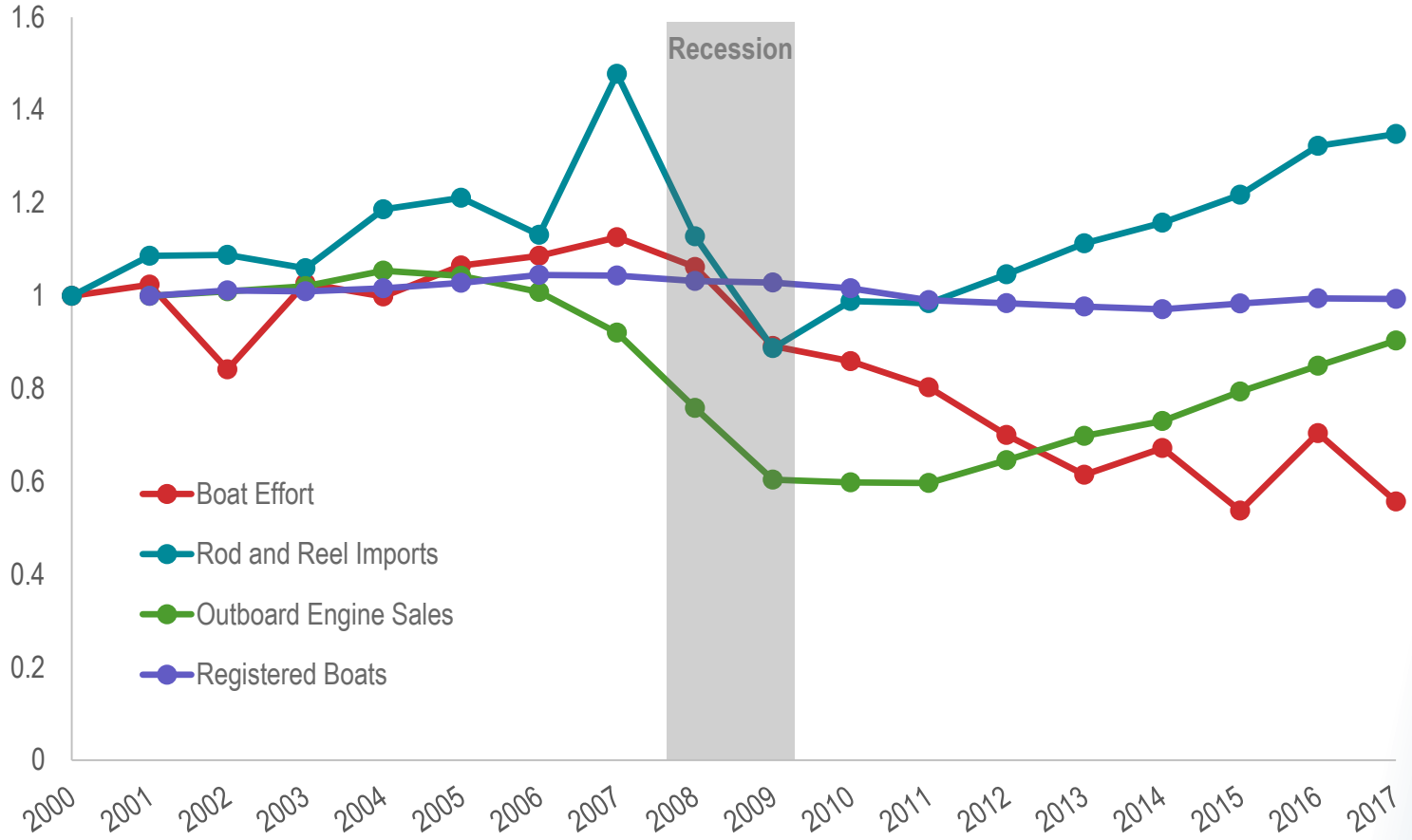
CHTS Effort Estimates

Private Boat Effort in Mid-Atlantic States



Taken together, these data suggest the recession had a relatively short-lived effect on fishing effort.

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Coverage Error

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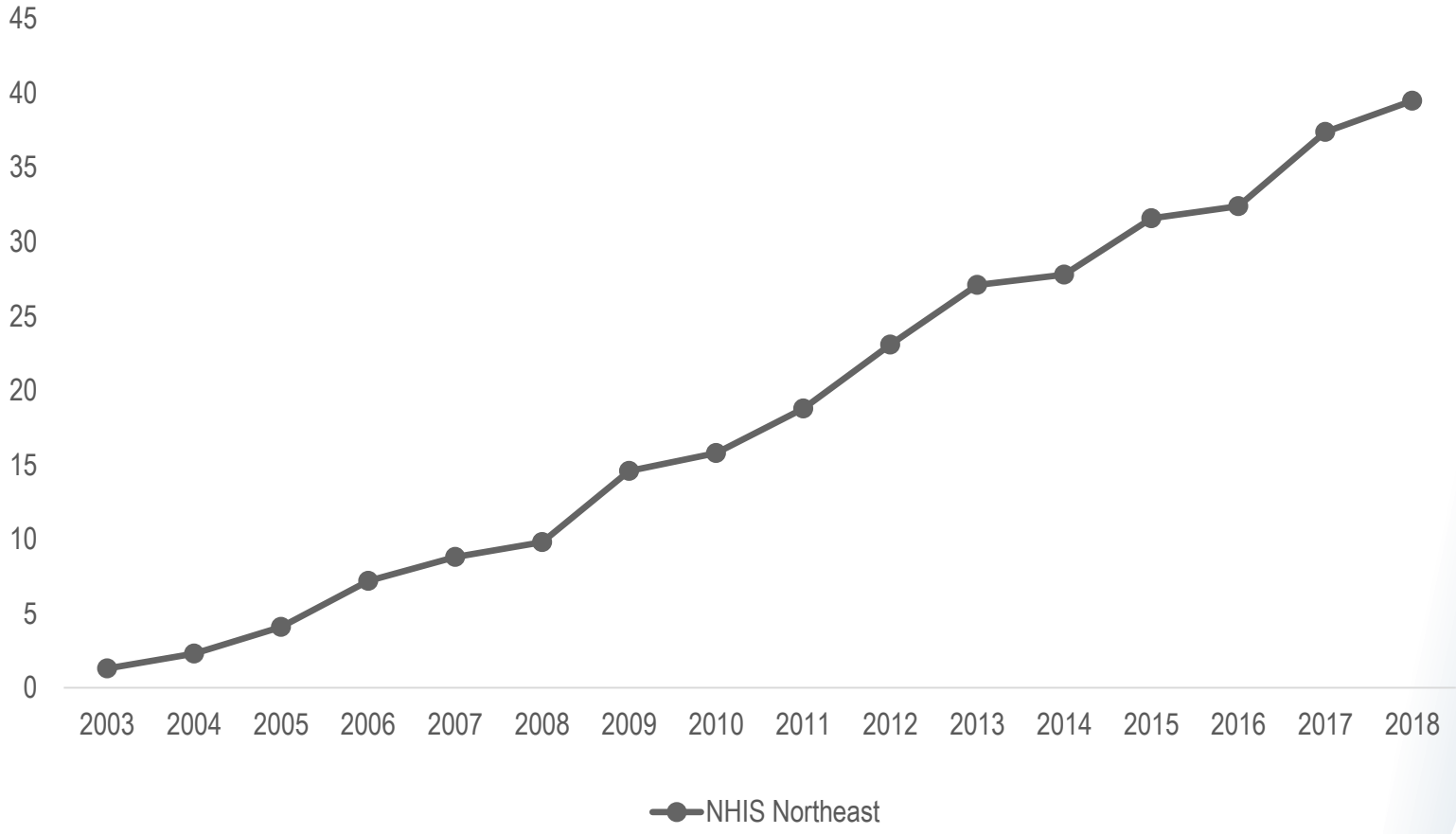
Percent of Adults in Wireless-Only Households
NHIS (Northeast)



As the number of Americans living in wireless-only households has increased, so has the number of households effectively excluded from the CHTS sample frame.

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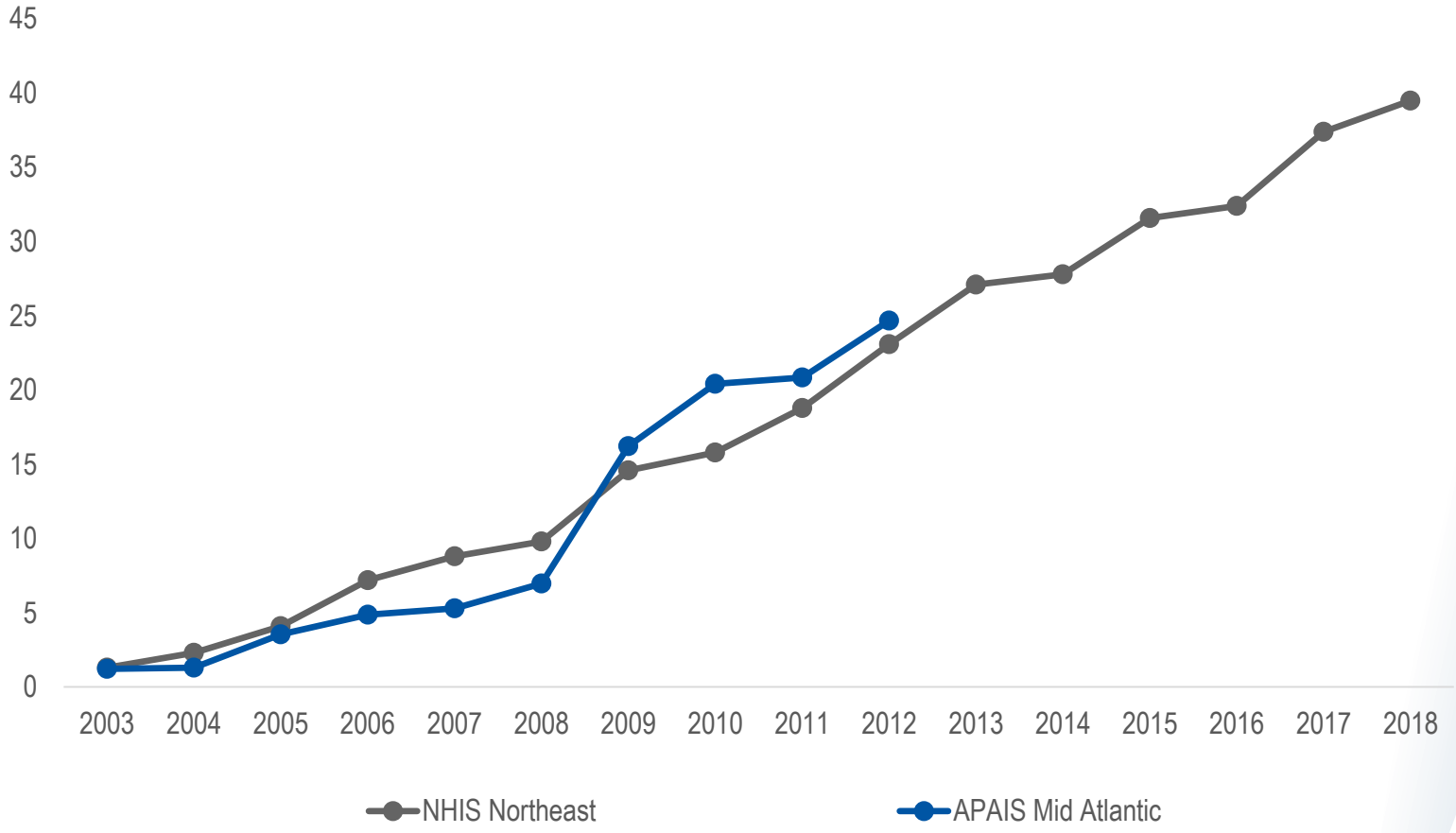
Percent of Adults in Wireless-Only Households
NHIS (Northeast) and APAIS (Mid-Atlantic)



As the number of Americans living in wireless-only households has increased, so has the number of households effectively excluded from the CHTS sample frame.

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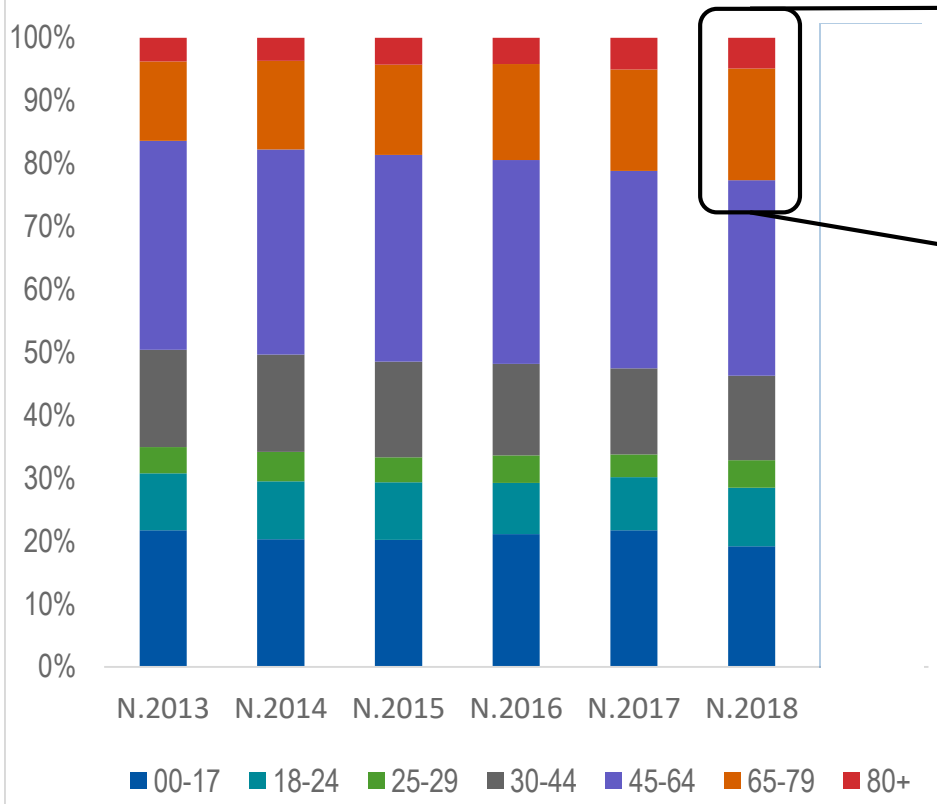
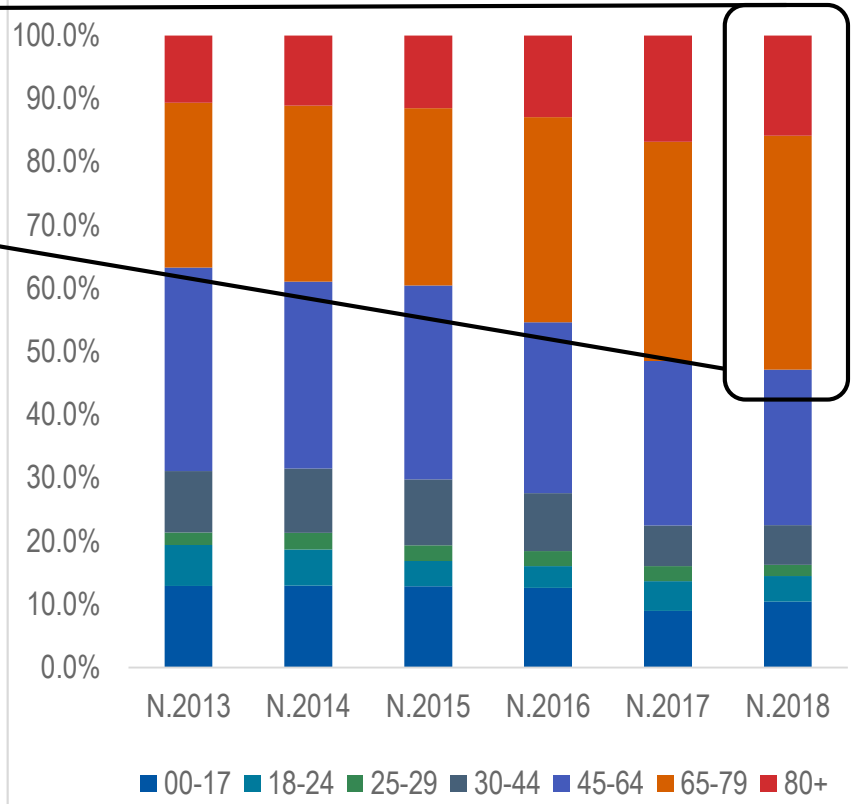
Age Distribution: All Households
NHIS: Northeast
APAIS: GA-ME



Age Distributions: Landline Households
NHIS: Northeast



The landline population is older, and exhibits characteristics associated with poor health. The age distribution of anglers more closely resembles the age distribution of the full population.

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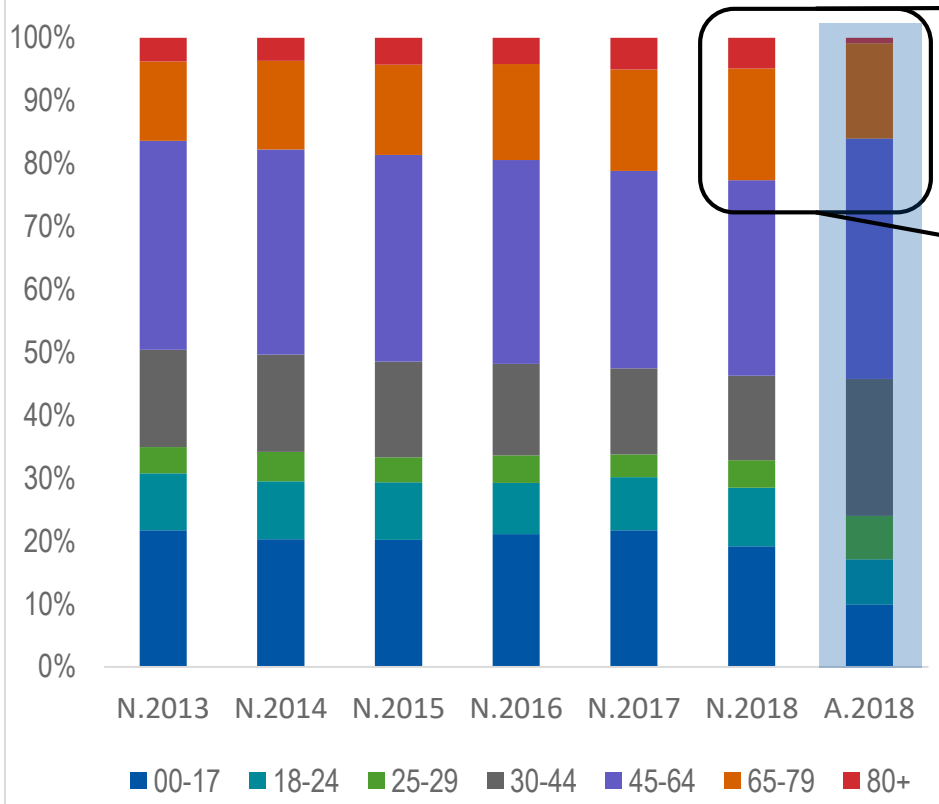
Age Distribution: All Households
NHIS: Northeast
APAIS: GA-ME



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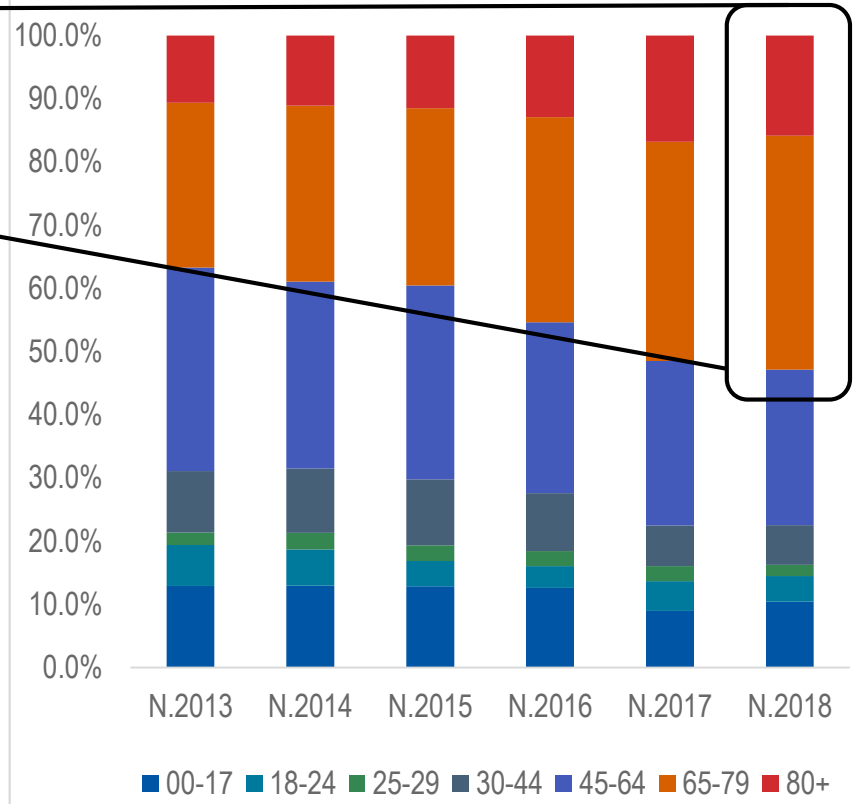

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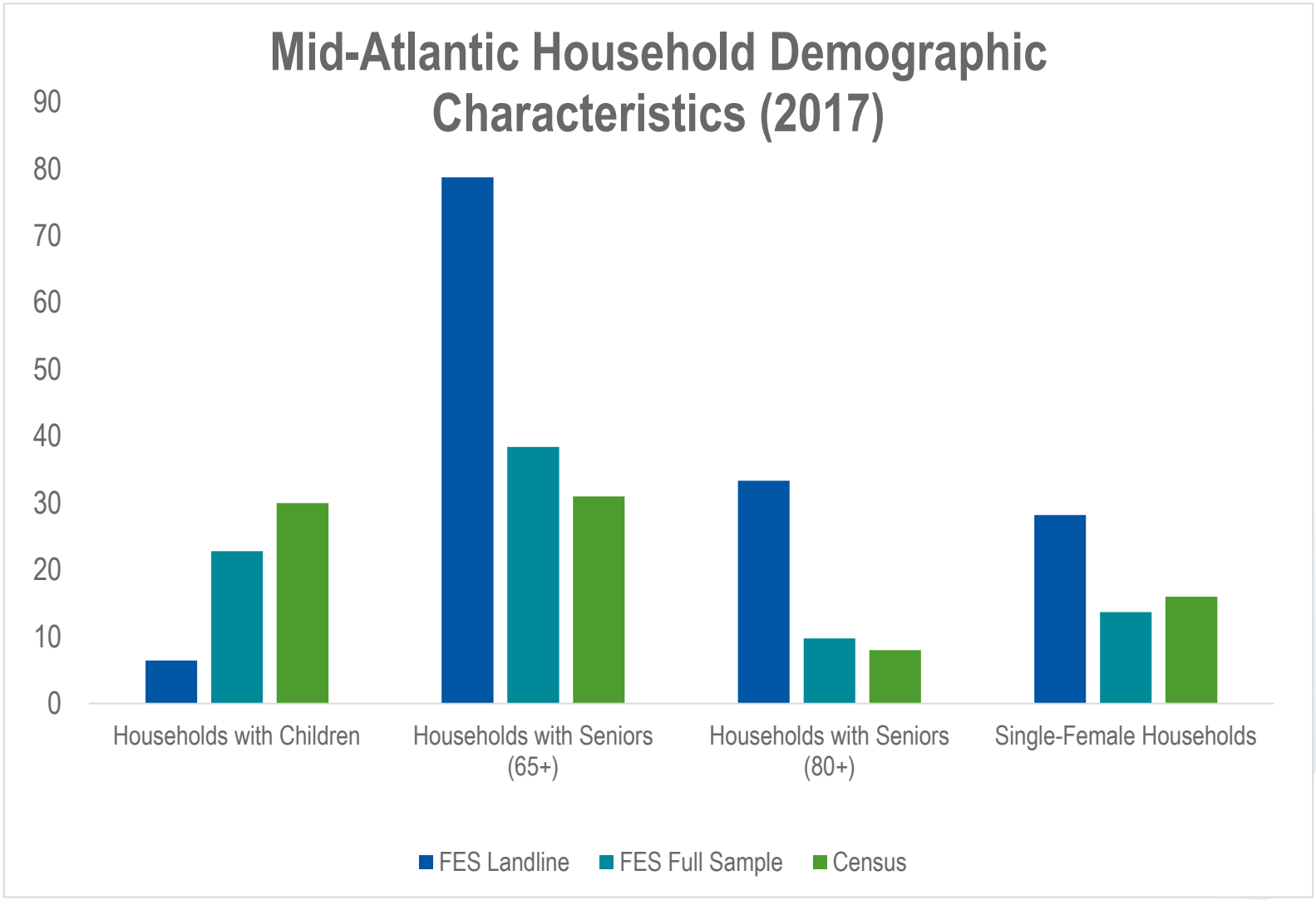

The Fishing Effort Survey's landline sample includes older residents, fewer children, and more households comprised of single women.

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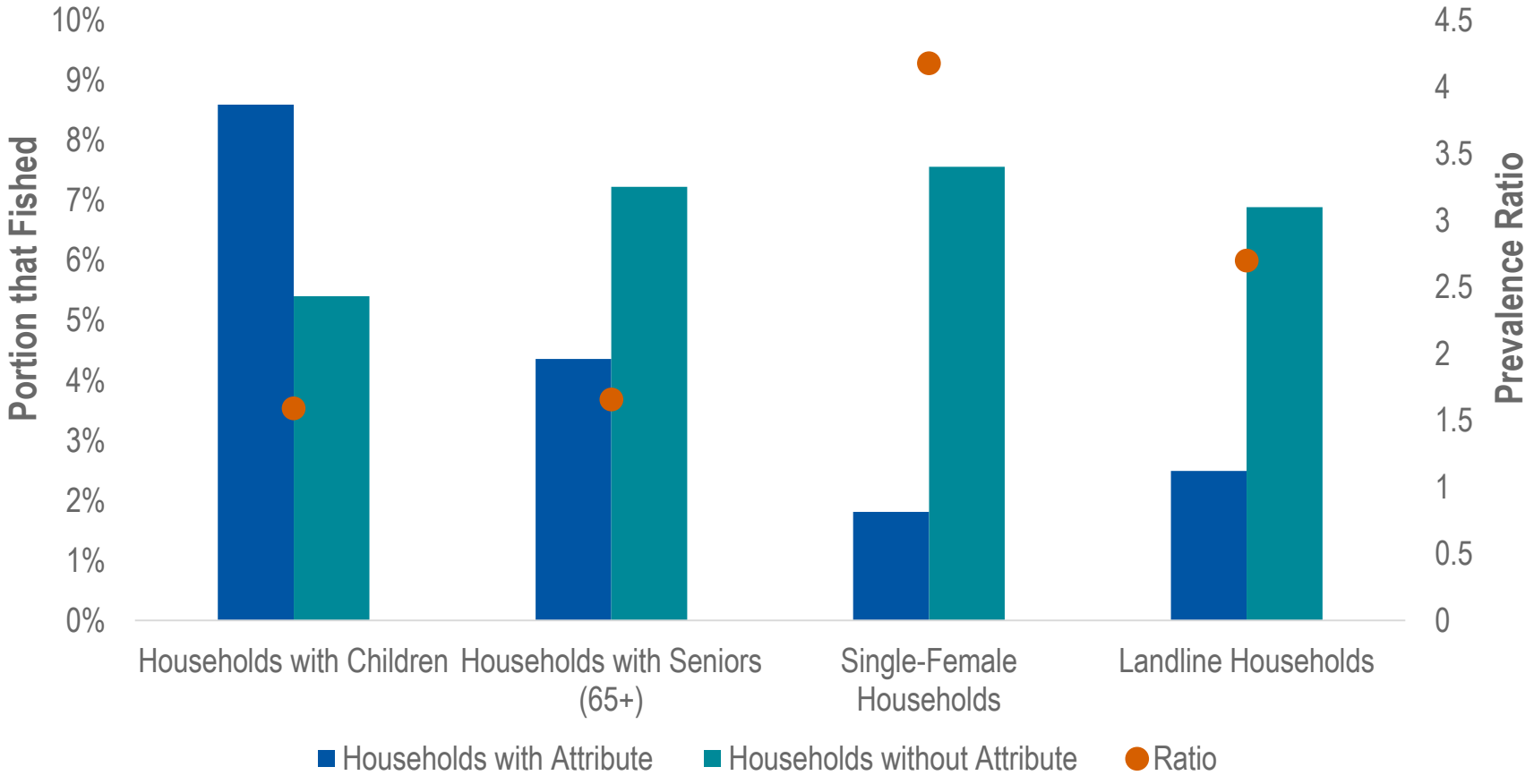
Mid-Atlantic Fishing Prevalence by Household Attribute (2017)



Demographic groups represented by the Fishing Effort Survey's landline sample are unlikely to participate in recreational fishing.

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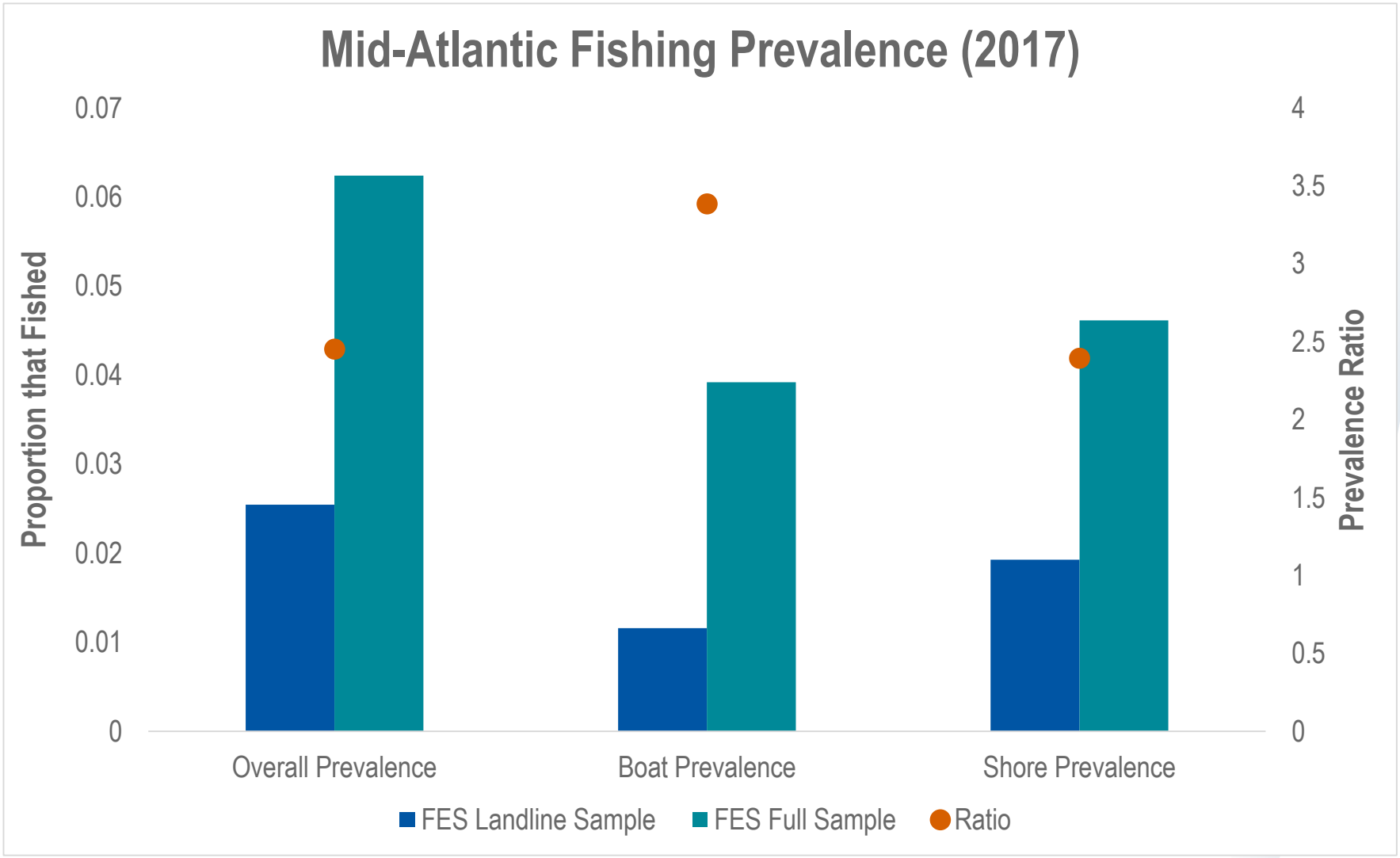

The Fishing Effort Survey's landline sample reports half of the fishing activity that is reported by the full sample.

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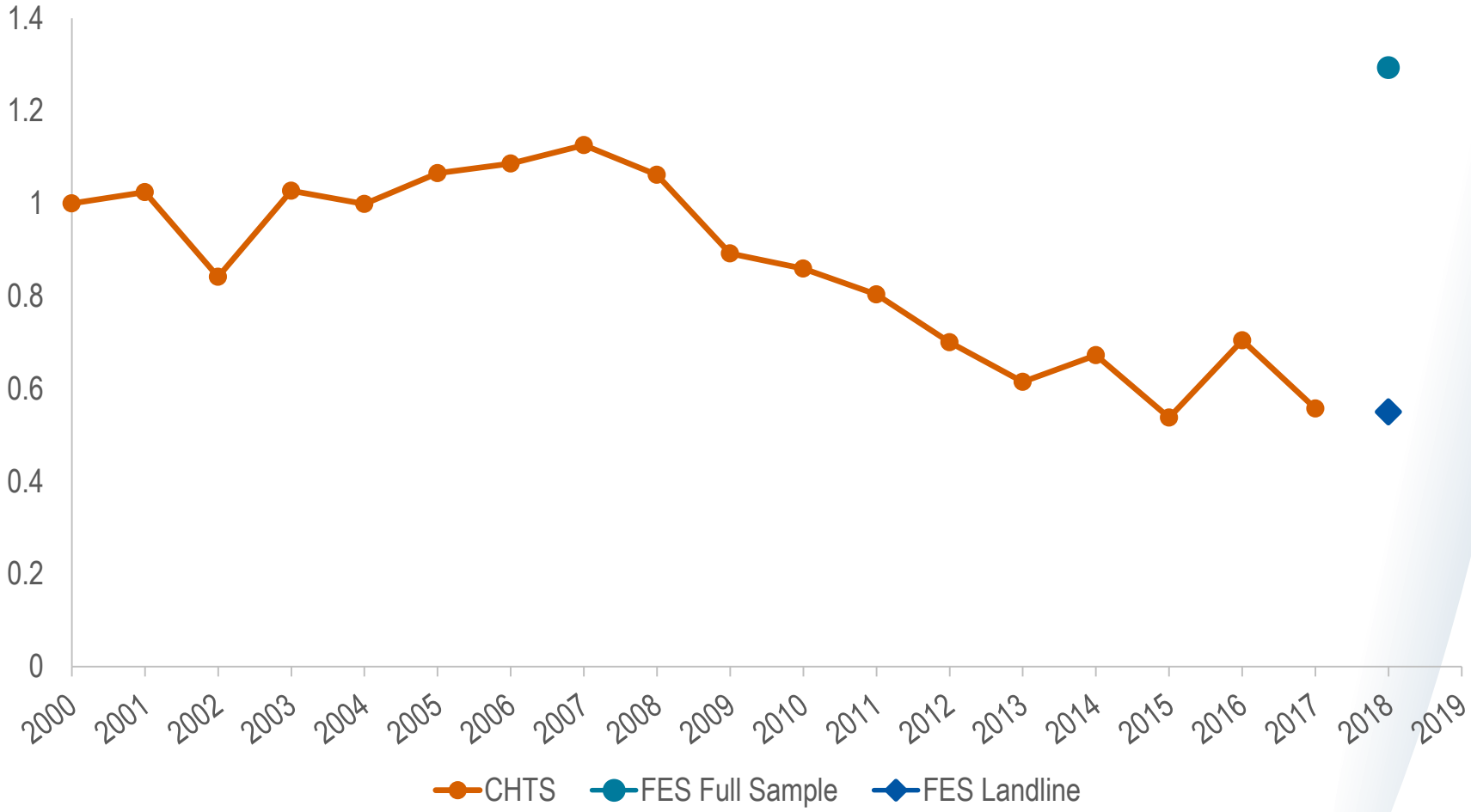
Indexed Estimates of Mid-Atlantic Private Boat Effort



Private boat estimates from the Fishing Effort Survey's landline sample resemble private boat estimates derived from the CHTS in its final year.

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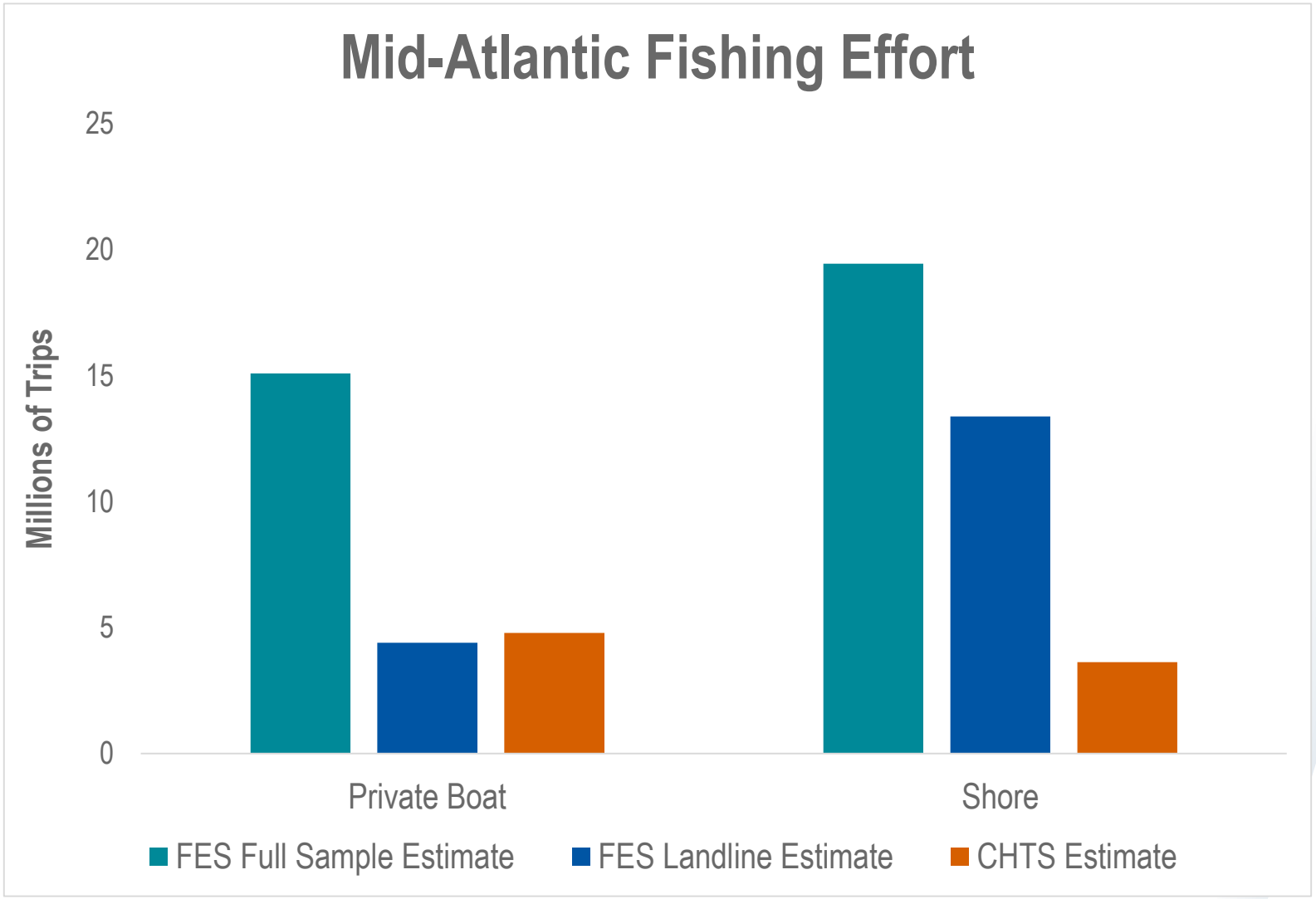

Coverage error explains a large portion of the differences between effort estimates, but other factors are also at play.

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The Gatekeeper Effect

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CHTS Screener Questions

- How many people in this household go fishing?
- How many people in your household, including children and adults, have been recreational saltwater fishing in the past 12 months in the U.S. or a U.S. territory?
- How many people in your household have been recreational saltwater fishing in the past two months in the U.S. or a U.S. territory?

About two-thirds of the time, the “gatekeeper” answering these questions was female. Did our screening process exclude eligible households from the Coastal Household Telephone Survey?

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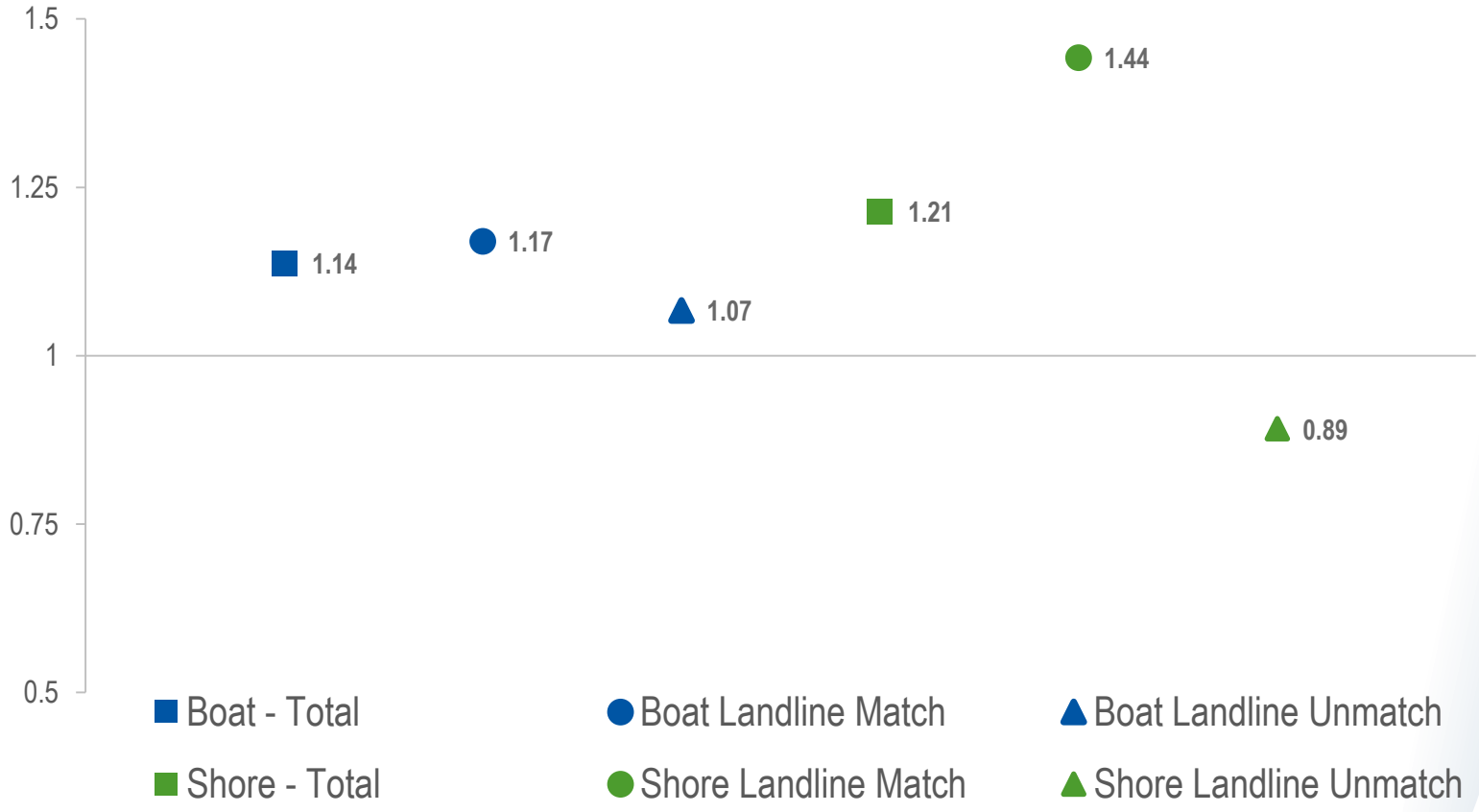
Prevalence Ratios: Licensed Angler vs. Initial Respondent Screening



Reported fishing was higher when we asked to speak with the licensed angler by name. The magnitude of the Gatekeeper Effect is greater on reported fishing from shore.

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The Gatekeeper Effect

- Women are more likely to answer a landline phone and less likely to report household fishing activity.
- The Gatekeeper Effect is real—particularly when it comes to reported shore fishing.
- In this pilot, the Gatekeeper Effect resulted in an underestimate of fishing effort by as much as 30%.

The Gatekeeper Effect is real, and the initial respondent matters.

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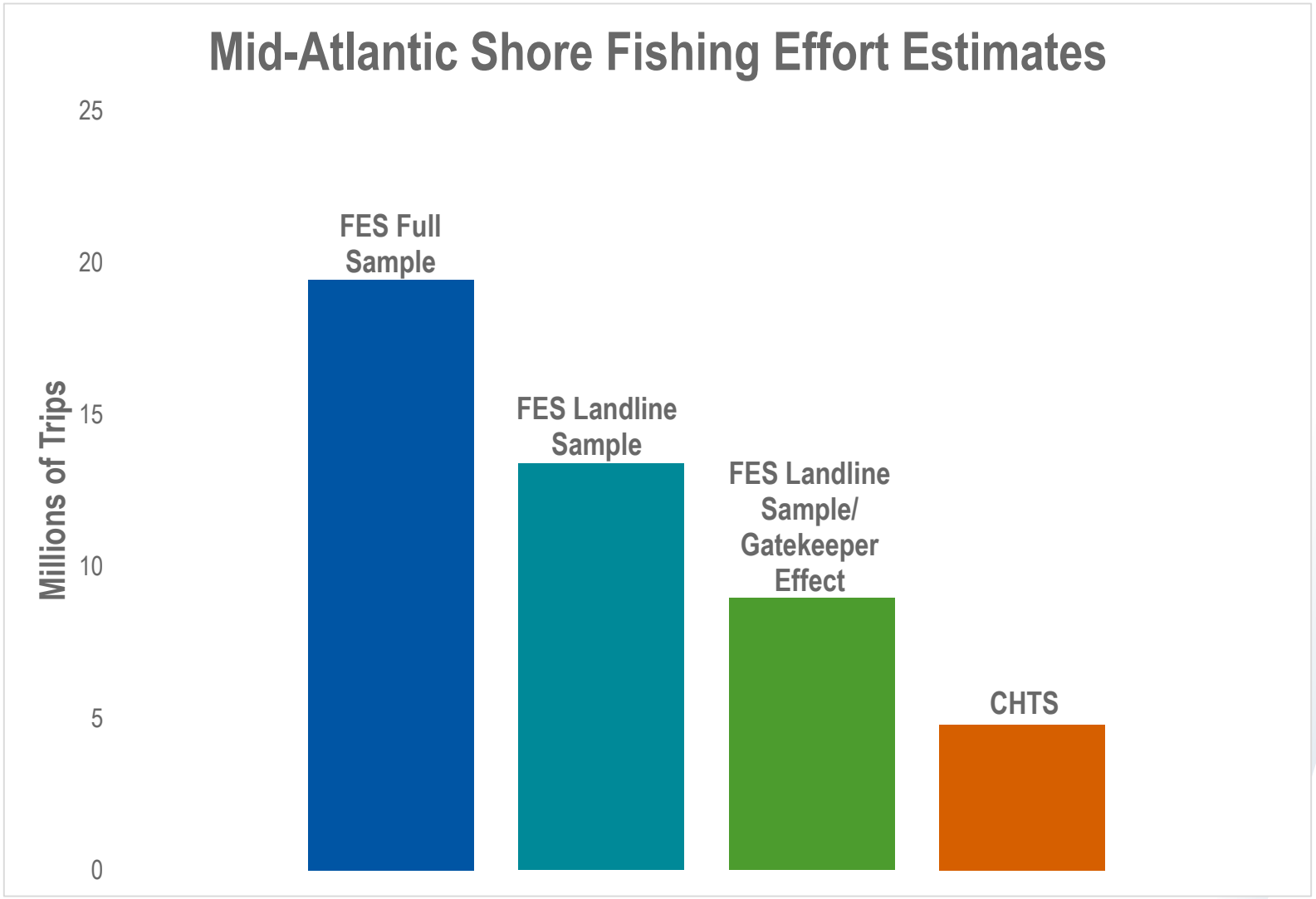

Under-coverage and the Gatekeeper Effect explain about 75% of the differences between estimates of shore effort.

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Plausibility

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Mid-Atlantic Fishing Effort
July-August 2018

	Percent of Residents Who Reported Fishing	Average Angler Trips
Shore	3.8%	3.2
Private Boat	2.8%	2.8
All Fishing Effort	**5%**	**4**

The Fishing Effort Survey still characterizes fishing as a rare event among the overall population.

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Does this level of fishing effort reflect what anglers can see from their boats or the shore?

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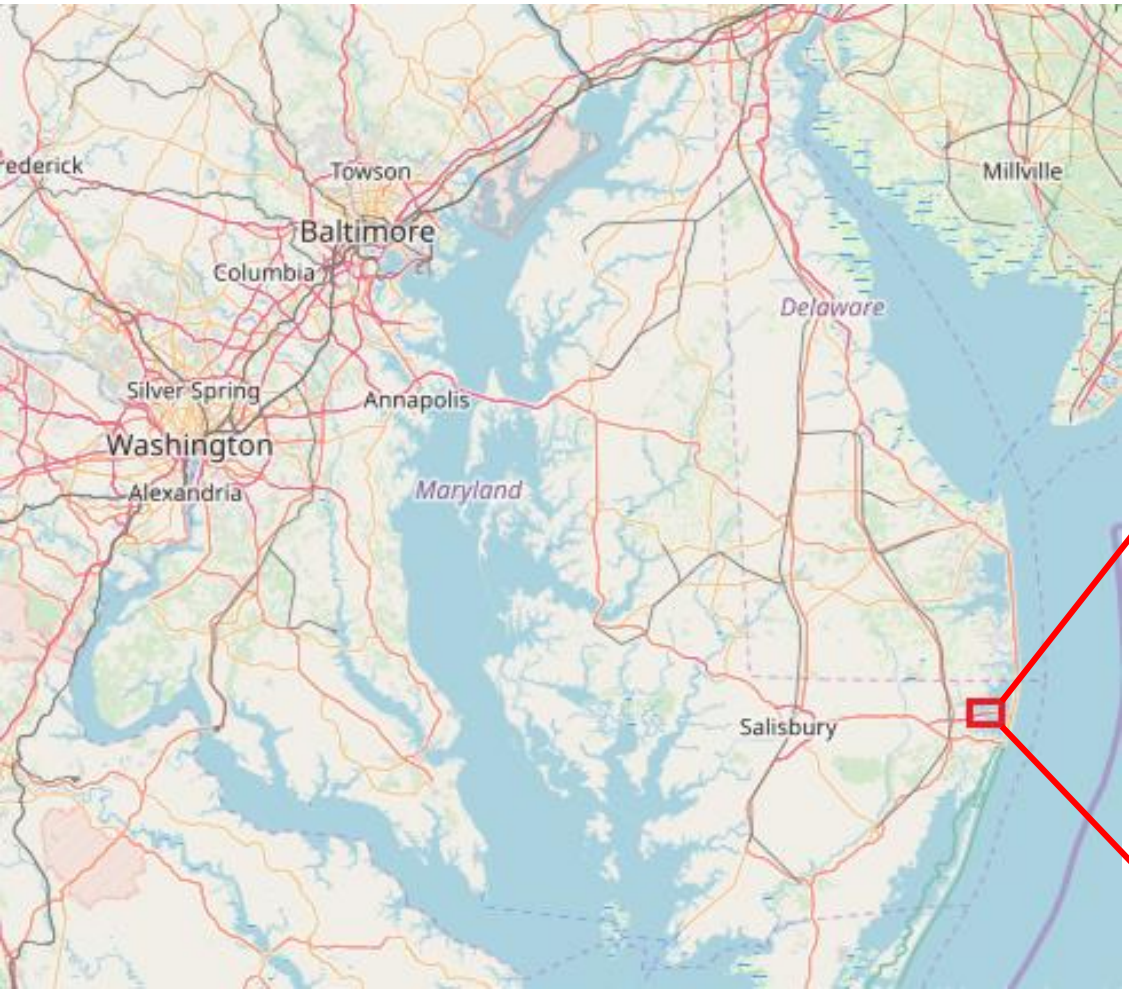
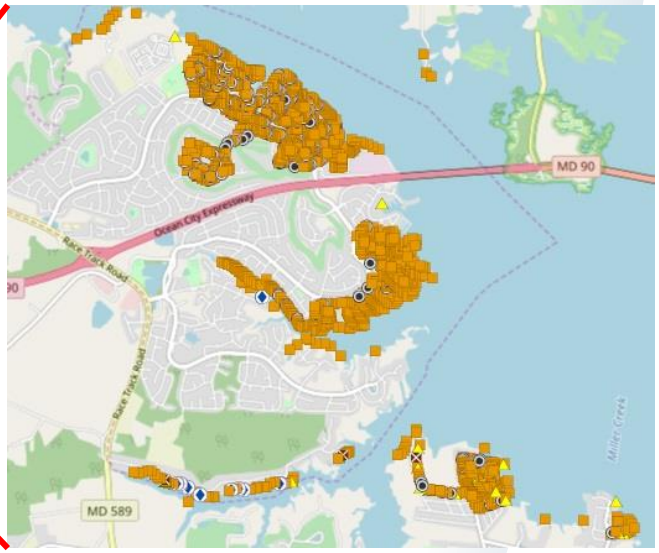


Ocean Pines:
<5 square miles, 1000+ docks



Almost 30,000 private docks, boat ramps, and boat houses can be found in the state of Maryland. This is 130 times the number of public fishing access sites in our sample frame.

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High-density residential areas have a high number of private fishing access sites.

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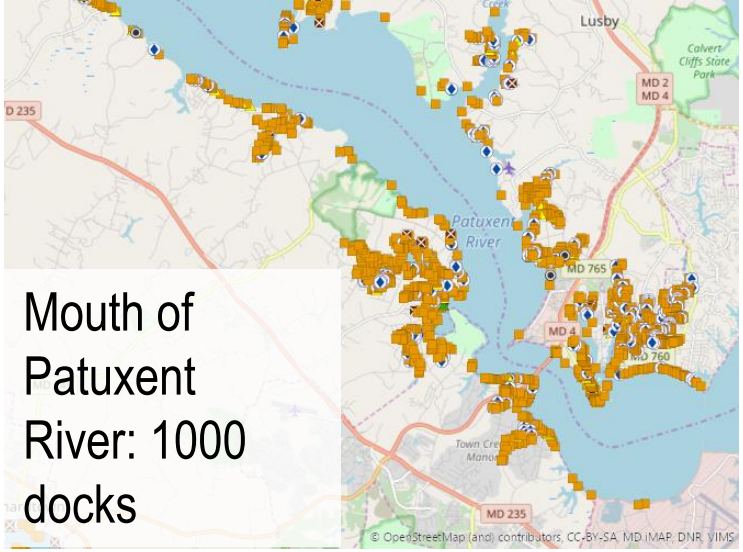
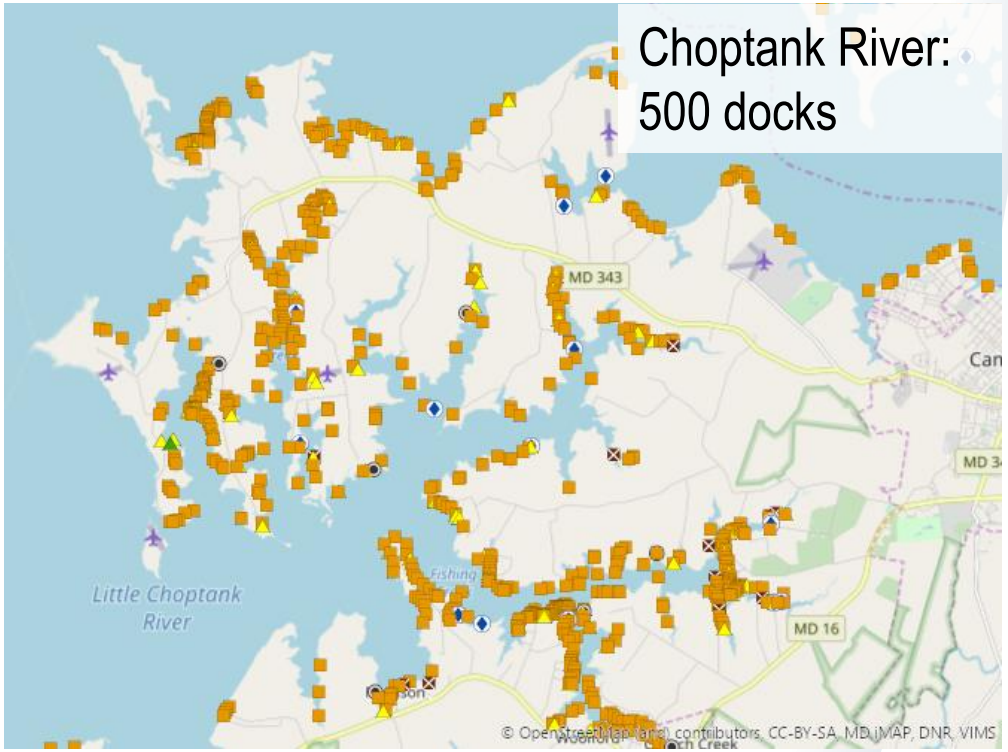
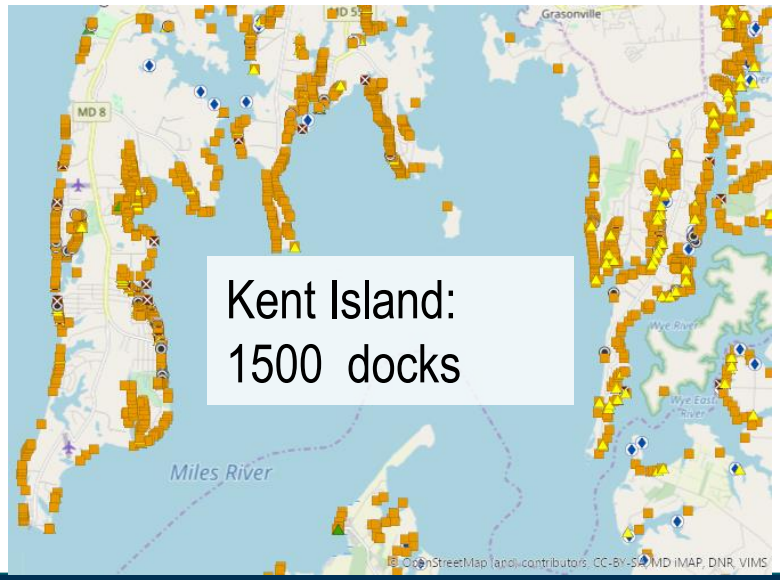


Mouth of Patuxent River: 1000 docks



Choptank River: 500 docks



Kent Island: 1500 docks

The potential magnitude of hidden fishing trips is tremendous.

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Summary

- In its later years, the declining coverage of the CHTS led to severe under-estimates of fishing effort.
- Screening errors in the CHTS also resulted in under-estimates of fishing effort.
- Coverage error and the Gatekeeper Effect explain a significant amount of the differences between FES and CHTS estimates.
- Despite larger estimates, the FES still characterizes fishing as a rare event.
- The potential magnitude of “hidden fishing trips” is enormous.

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Presentation Outline

I. Explaining Differences Between FES and CHTS

II. Survey Design and Estimation Methods

III. Calibration Methods

IV. Case Study: Bluefish

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APAIS Overview

- In-person **interviews of anglers** intercepted at **public access fishing sites**
- Sample frame derived from NOAA Fisheries Public Fishing Access Site Register
- Data collected continuously, used to **estimate catch rates** and trip characteristics for two-month waves

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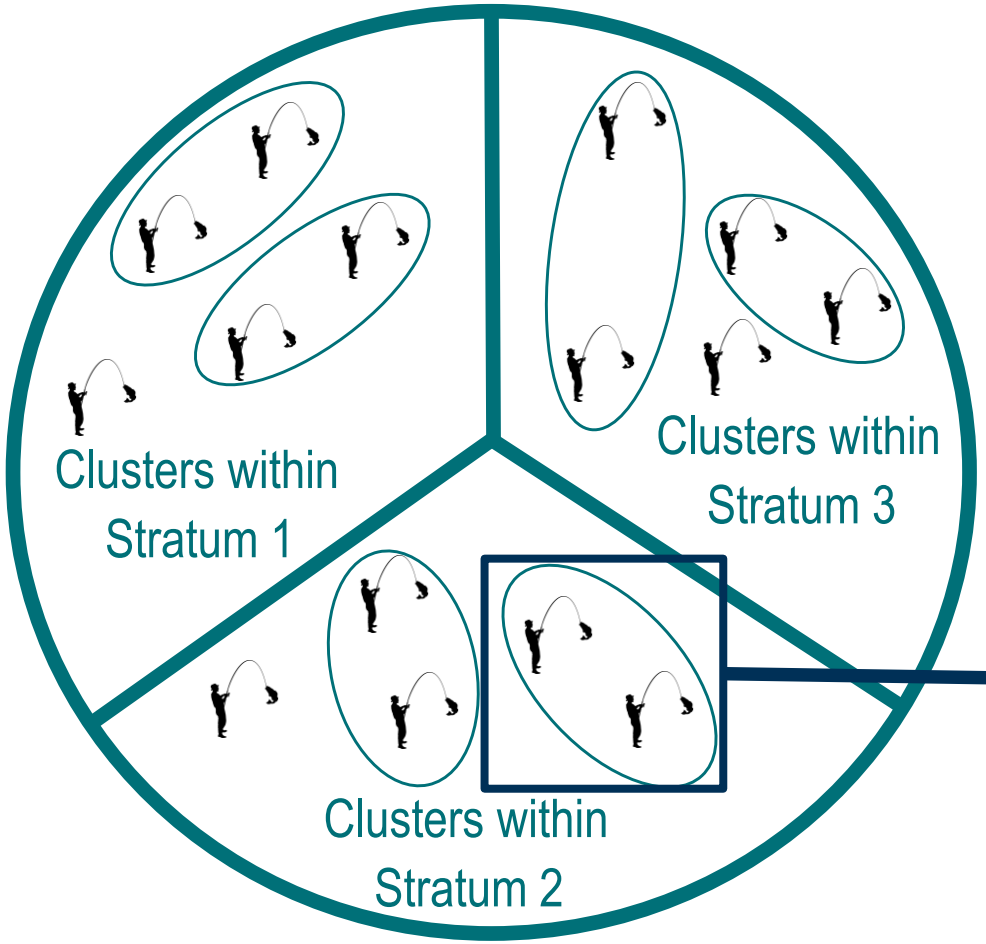
APAIS Design

Stratified, clustered multi-stage design



Primary Stage Unit (PSU):
Site Cluster-Day-Time Interval

Secondary SU:
Sample Duration (time spent sampling each site in a cluster)

Tertiary SU:
Angler Trips

Quaternary SU:
Catch

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APAIS Sample Selection

- Probability of selecting PSU's based on **fishing pressure**
  - Higher probability of selecting high pressure sites

Expected Number of Angler-Trips	Size Measure (Weight)
1-4 Angler-trips	0.5
5-8	2.5
9-12	9
13-19	13
20-29	20
30-49	30
50-79	50
80+	80
Mode not present at site/site is inactive	0

APAIS sample selection is based on stratified **probability proportional to size without replacement**, with logistical field constraints (e.g. available samplers per day) incorporated into the process

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FES Overview

- **Self-administered mail survey** conducted annually in six, two-month waves
- Sample frame: a comprehensive directory of **residential addresses serviced by USPS**
- Sample selection: simple random sampling of households in each stratum
- Used to **estimate private boat and shore mode effort estimates** for all in-state resident anglers

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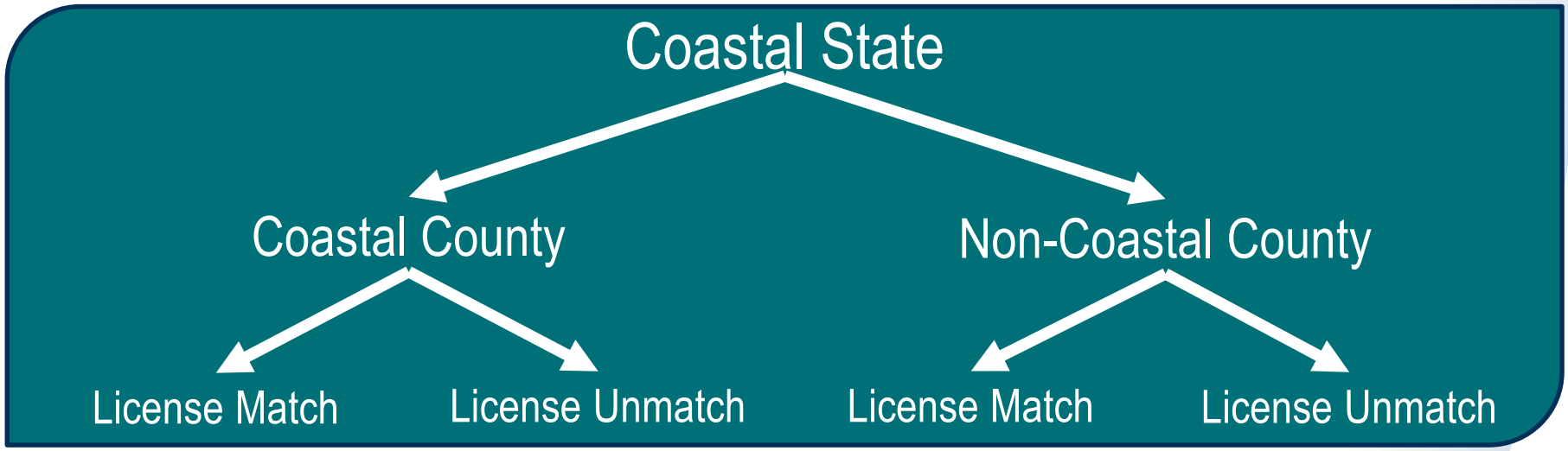
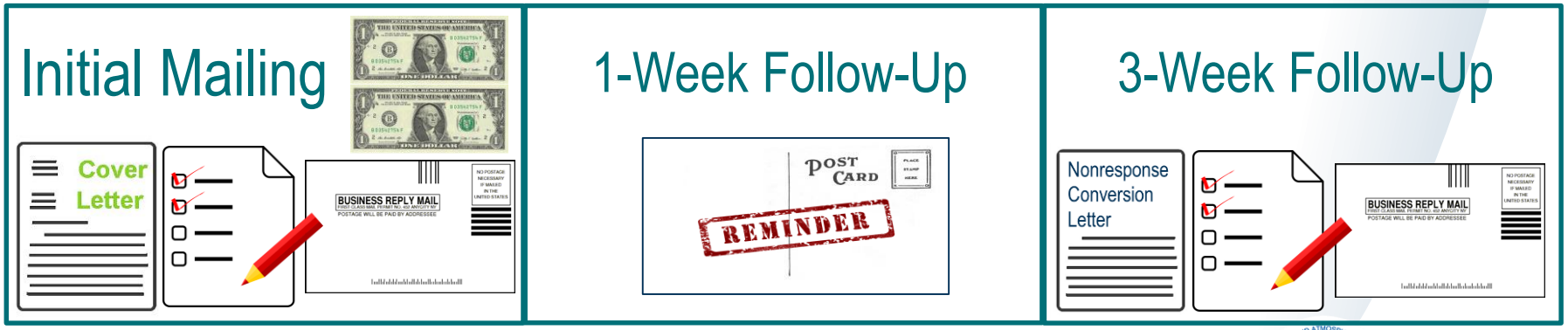
FES Design

Stratification



Data Collection



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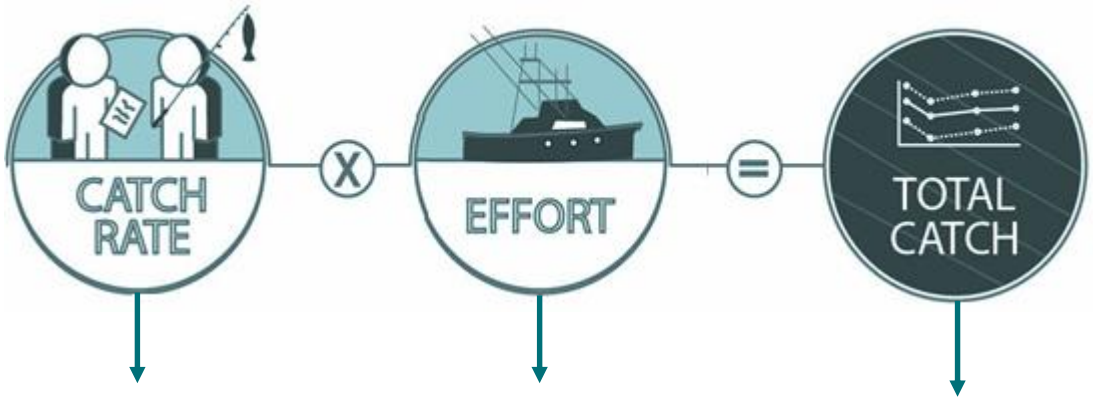
Catch Estimation – Basic



Estimated number of angler trips

Estimated number of fish caught per angler trip

Estimated total number of fish caught

RESOURCES

Survey Design and Statistical Methods for Estimation of Recreational Fisheries Catch and Effort

December 31, 2018

This document describes the technical details of the Marine Recreational Information Program's suite of recreational fishing surveys, as well as the methods it uses to produce estimates of total recreational catch.

PDF

Document | National

For more detailed estimation methods, see countmyfish.noaa.gov

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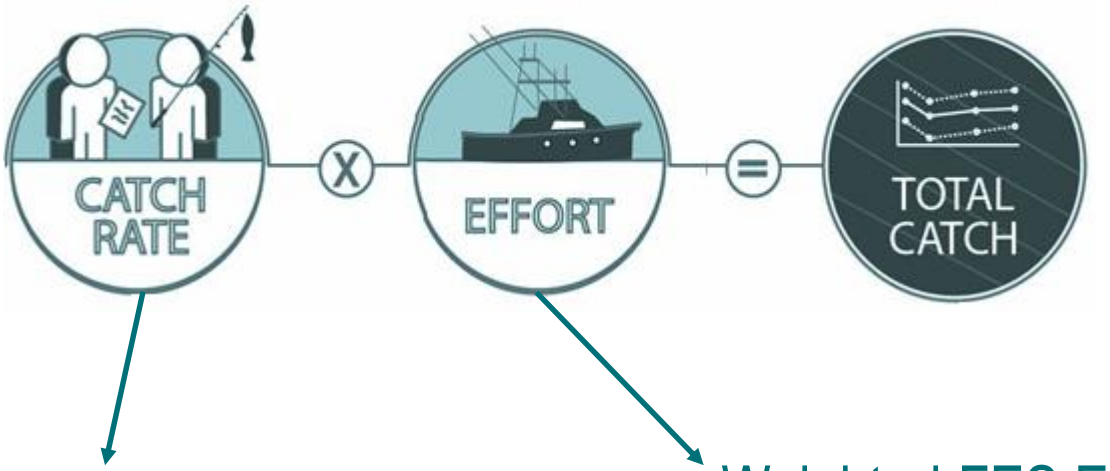
Catch Estimation – Broken Down



Weighted APAIS catch rate

- includes 3 sample weighting components
- calculated using standard weighted mean estimator

Weighted FES Effort

- includes 3 sample weighting components
- calculated using standard weighted total estimator
- **From APAIS**: an adjustment factor to account for out-of-state angler trips
- **From APAIS**: partitioned by area fished (inland, nearshore, offshore)

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APAIS Sample Weights

PSU – Stage I Sample Weight

$$w_1 = \frac{1}{inclusion\ probability}$$

Sample Duration – Stage II Sample Weight

$$w_2 = \frac{length\ of\ assigned\ time\ interval}{time\ spent\ subsampling\ at\ a\ site\ within\ a\ cluster}$$

Angler-Trip – Stage III Sample Weight

$$w_3 = \frac{Total\ angler\ trips\ observed\ at\ a\ site}{Total\ angler\ trips\ intercepted\ at\ a\ site}$$

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APAIS Catch Rate Estimates

Mean catch per angler trip is calculated as a **domain estimate**, defined by year, wave, region, state, fishing mode, area fished (inland, nearshore, offshore), species and catch type (e.g. harvested, released):

Final sample weight ($w_1 * w_2 * w_3$) for angler trip in domain d

Number of fish caught on angler trip in domain d

Catch rate in domain d

$$\hat{\bar{y}}_d = \frac{\sum w_d y_d}{\sum w_d}$$

This is a standard weighted mean estimator used in survey statistics (e.g. SAS Institute Inc, 2016)

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FES Sample Weights

1. Base design weight Of household i in stratum h	$w_{hi} = \frac{1}{inclusion\ probability}$
2. Nonresponse adjustment Done to minimize response bias	Sample partitioned into nonresponse adjustment cells, and adjusted by response rates (w_{hi}^{*})
3. Post-stratification adjustment Done to improve representativeness of sample (common technique used to conform population totals to an independent survey)	Sample matched to demographic controls from the U.S. Census Bureau's American Community Survey residential household estimates (w_{hi}^{**})

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FES Effort Estimates

Estimated number of angler trips by year, wave, region, state, fishing mode

$$\hat{T} = \sum w_{hi}^{**} t_{hi}$$

Trips taken by household i *in stratum* h

Final sample weight of household *i* in stratum h (comprised of base weight, nonresponse weight and post-stratification adjustment)

This is a Horvitz-Thompson total estimator (Horvitz and Thompson 1952), a standard method for estimating the total of a stratified sample.

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Total Catch Estimates

Total catch (Wave)

Weighted FES effort, adjusted for out of state trips and partitioned by area fished

$$\hat{Y}_d = \hat{T} * \hat{\bar{y}}_d$$

Weighted APAIS catch rate estimate

Total catch (Annual)

$$\hat{Y}_D = \sum \hat{Y}_d$$

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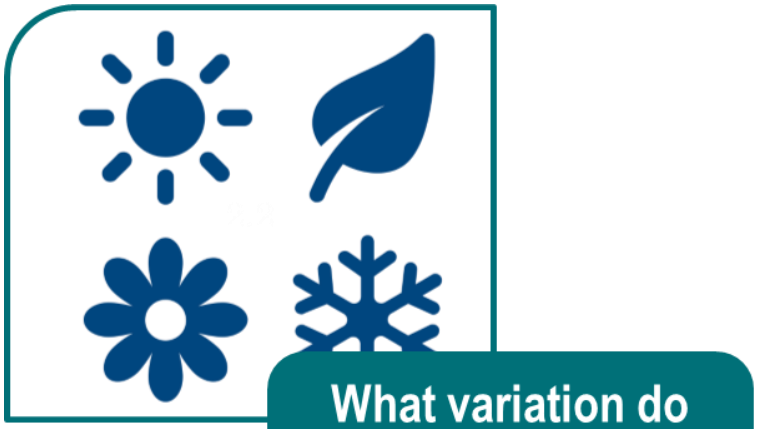
FES Calibration

- FES and CHTS ran side-by side for a 3-year benchmarking period (2015-2017)
- Fay-Herriot small area estimation model fit to relate both sets of estimates
- Variables incorporated into the model:



What variation do the old and new estimates share?

Where are there consistent differences?

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Shared Variation

Estimated Effort = **True Effort** + Nonsampling Error + Sampling Error

Changes in fishing effort from year to year - Modeled using state-specific population sizes from U.S. Census Bureau

Trend

Changes not captured by other variables – modeled as random effects, estimated using Fay-Herriot Methodology

Irregular

Seasonal

State-level changes – modeled using an indicator variable

State

Changes in fishing effort from season to season - Modeled using indicators for the six two-month waves in each state

What variation do the old and new estimates share?

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Differences

$$\text{Estimated Effort} = \text{True Effort} + \textbf{Nonsampling Error} + \textbf{Sampling Error}$$

- **Non-Sampling Error:** Emergence of wireless-only households from 2000-2017 National Center for Health Statistics
- **Sampling Error**: estimated for each survey using the variances of FES fishing effort estimates and CHTS fishing effort estimates

Where are there consistent differences?

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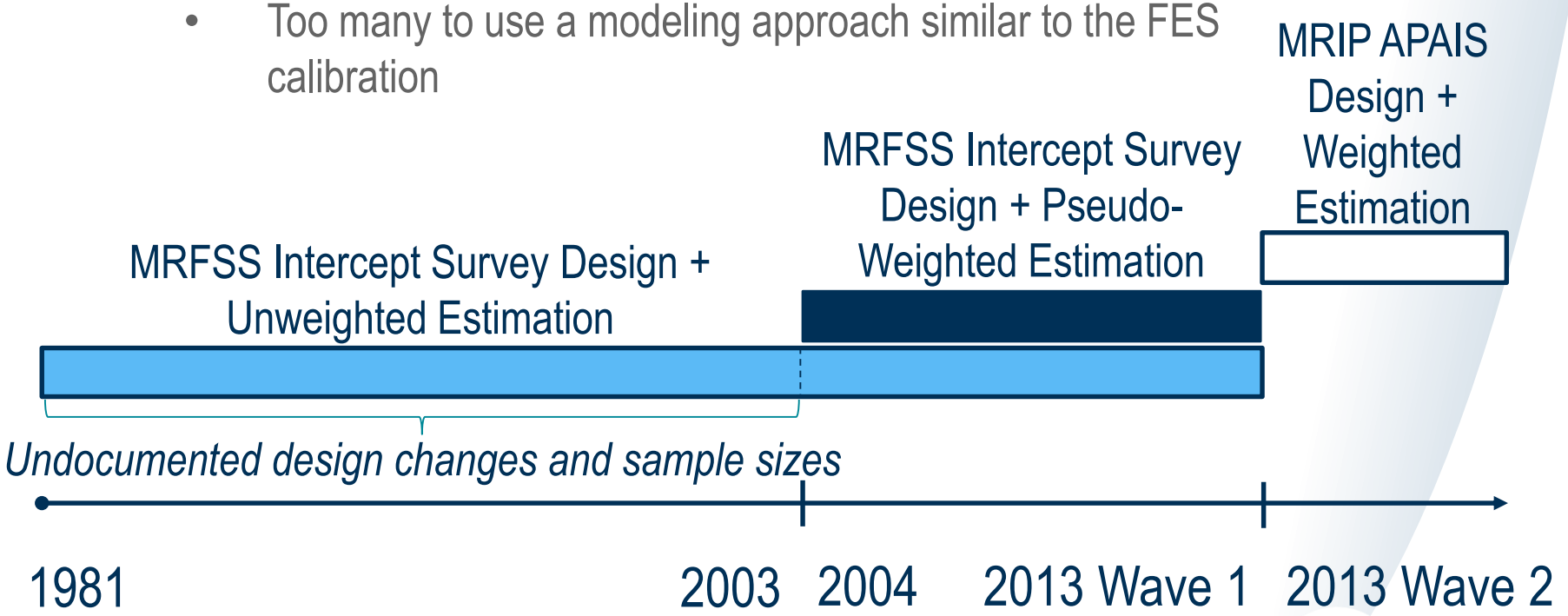
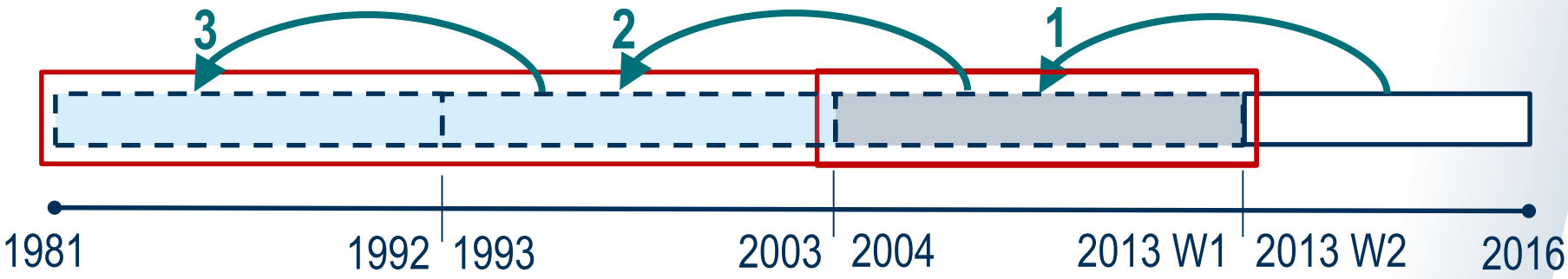
APAIS Calibration: Challenges

- 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



Sample Weight Adjustments

- 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



- Domains used: 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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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 $R_d \approx 1$ (final weight ≈ iterated weight)

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For full details, see countmyfish.noaa.gov

RESOURCES

Survey Design and Statistical Methods for Estimation of Recreational Fisheries Catch and Effort

December 31, 2018

This document describes the technical details of the Marine Recreational Information Program's suite of recreational fishing surveys, as well as the methods it uses to produce estimates of total recreational catch.

PDF

Document | National

EVENTS

Fishing Effort Survey Calibration Model Peer Review

In 2017, NOAA Fisheries convened a peer review of a calibration model proposed by the Marine Recreational Information Program to support its transition from the Coastal Household Telephone Survey to a new mail Fishing Effort Survey.

Workshop/Conference

EVENTS

Access Point Angler Intercept Survey Calibration Workshop

In 2018, NOAA Fisheries convened a peer review of a method of producing revised historical catch statistics that are comparable to those produced by the improved Access Point Angler Intercept Survey.

Workshop/Conference

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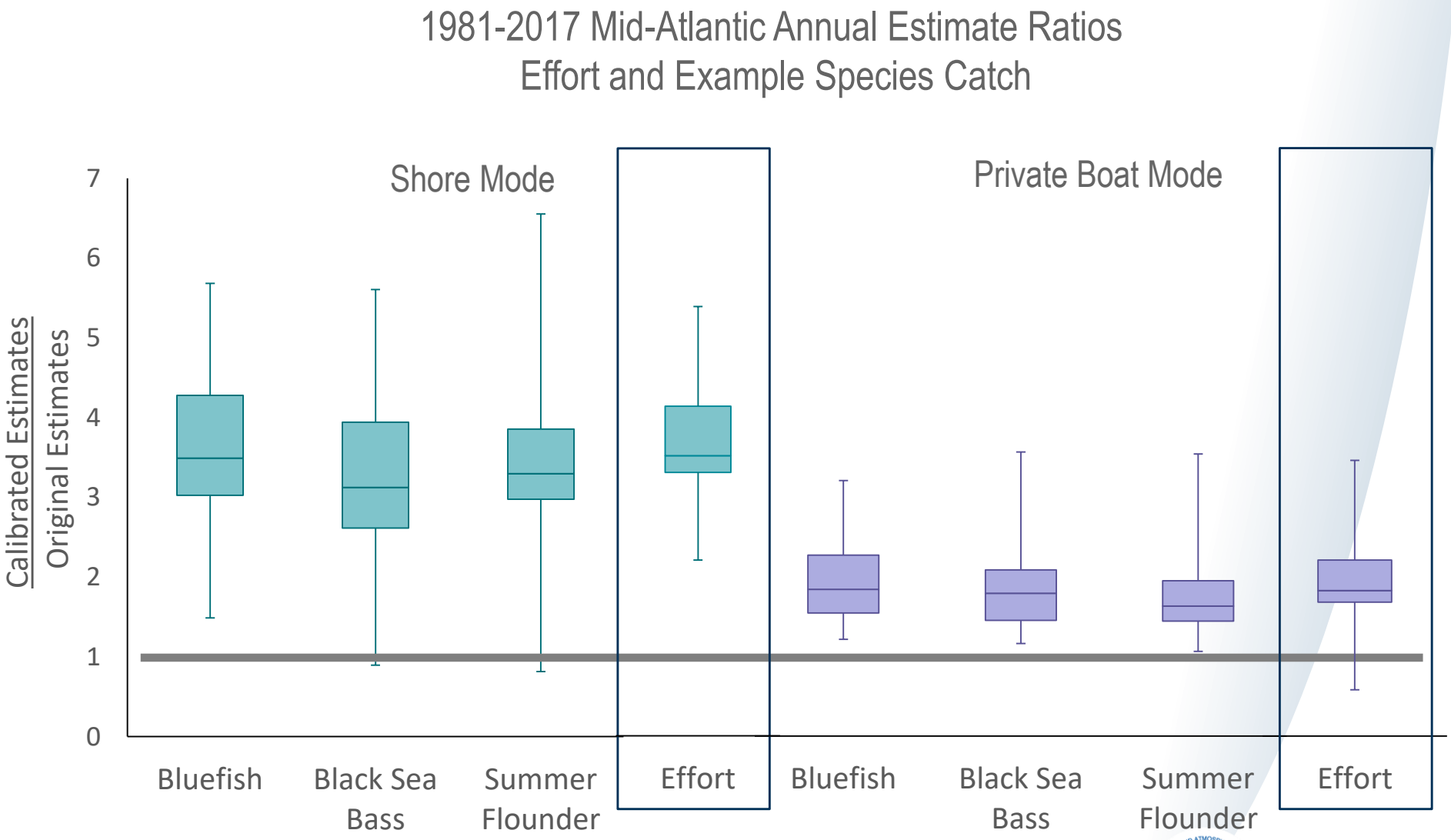
Effects on Time Series – APAIS+FES Calibration



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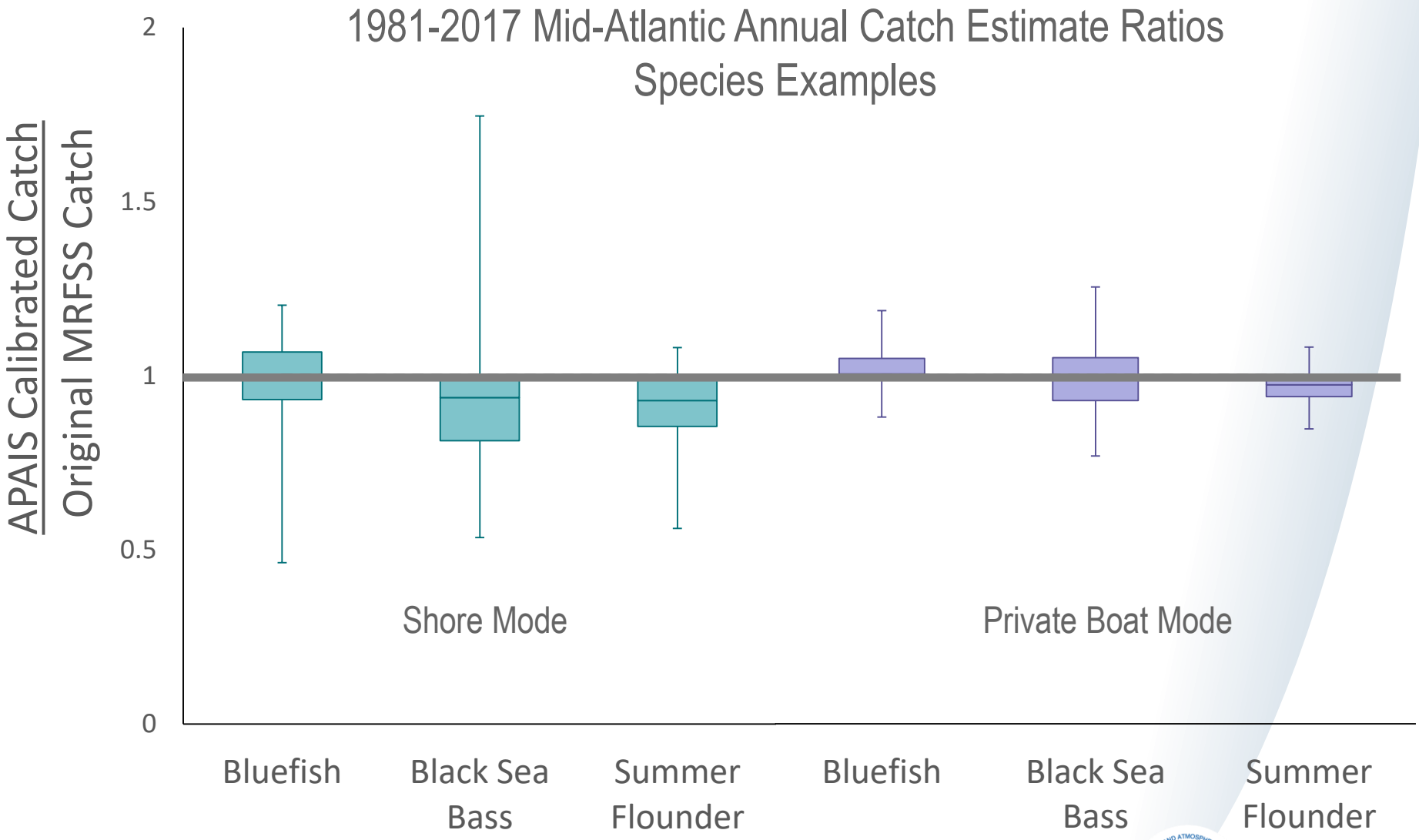
Effects on Time Series – APAIS Calibration



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Presentation Outline

I. Explaining Differences Between FES and CHTS

II. Survey Design and Estimation Methods

III. Calibration Methods

IV. Case Study: Bluefish

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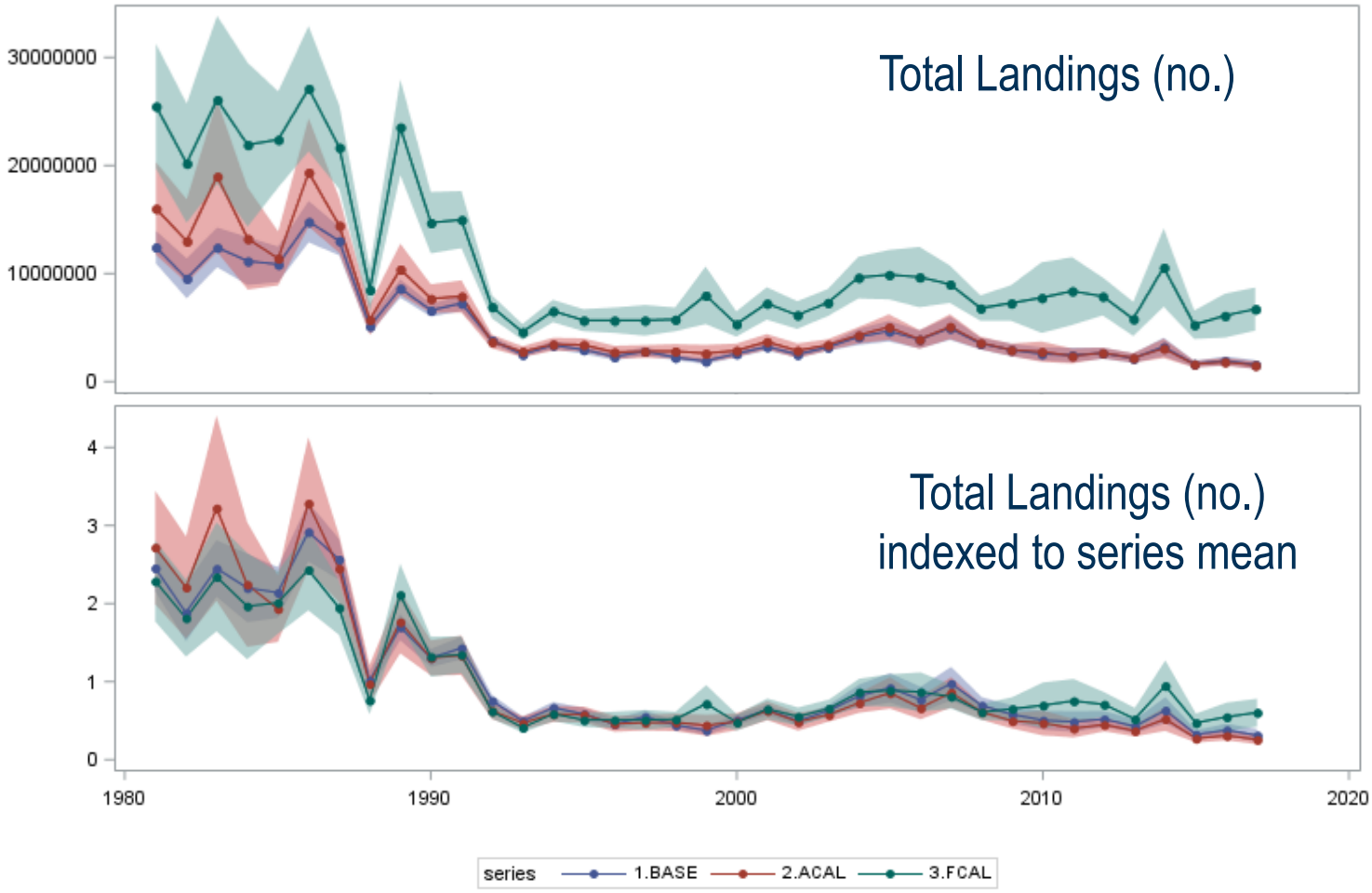
Bluefish

- Three estimate series:
  - **BASE:** uncalibrated estimates
  - **ACAL:** estimates calibrated for APAIS only
  - **FCAL:** estimates fully calibrated for APAIS and FES
- Trends in landings, releases
- Change ratios among series
- Comparisons of PR and SH estimates and data patterns for Bluefish and Striped Bass, Black Sea Bass, Summer Flounder, Scup

MRIP Mid-Atlantic Bluefish Total Annual Landings



Overall decline and inter-annual changes similar among all estimate series, change in FCAL series in recent years. Shaded regions indicate 95% confidence interval.

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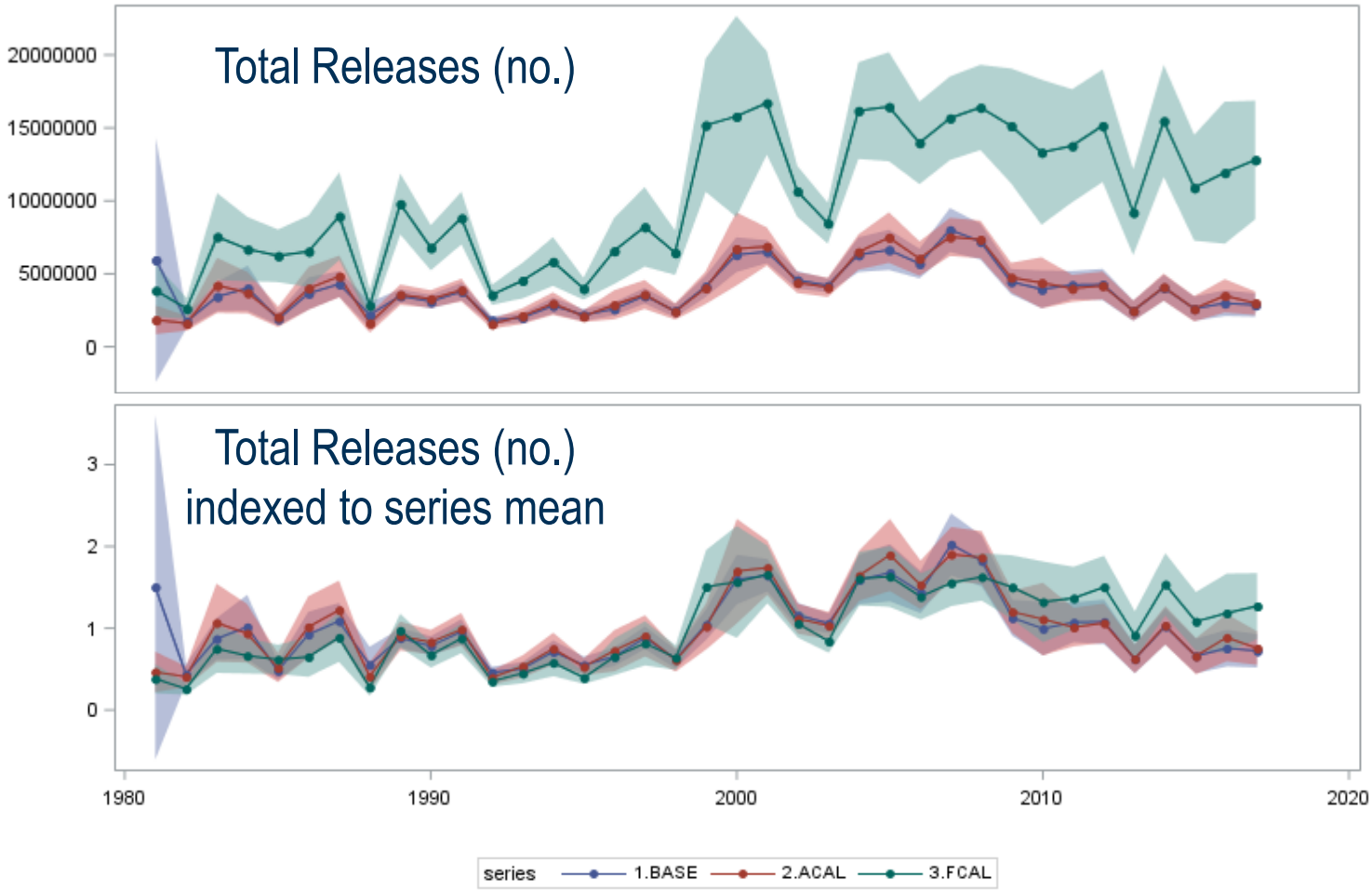
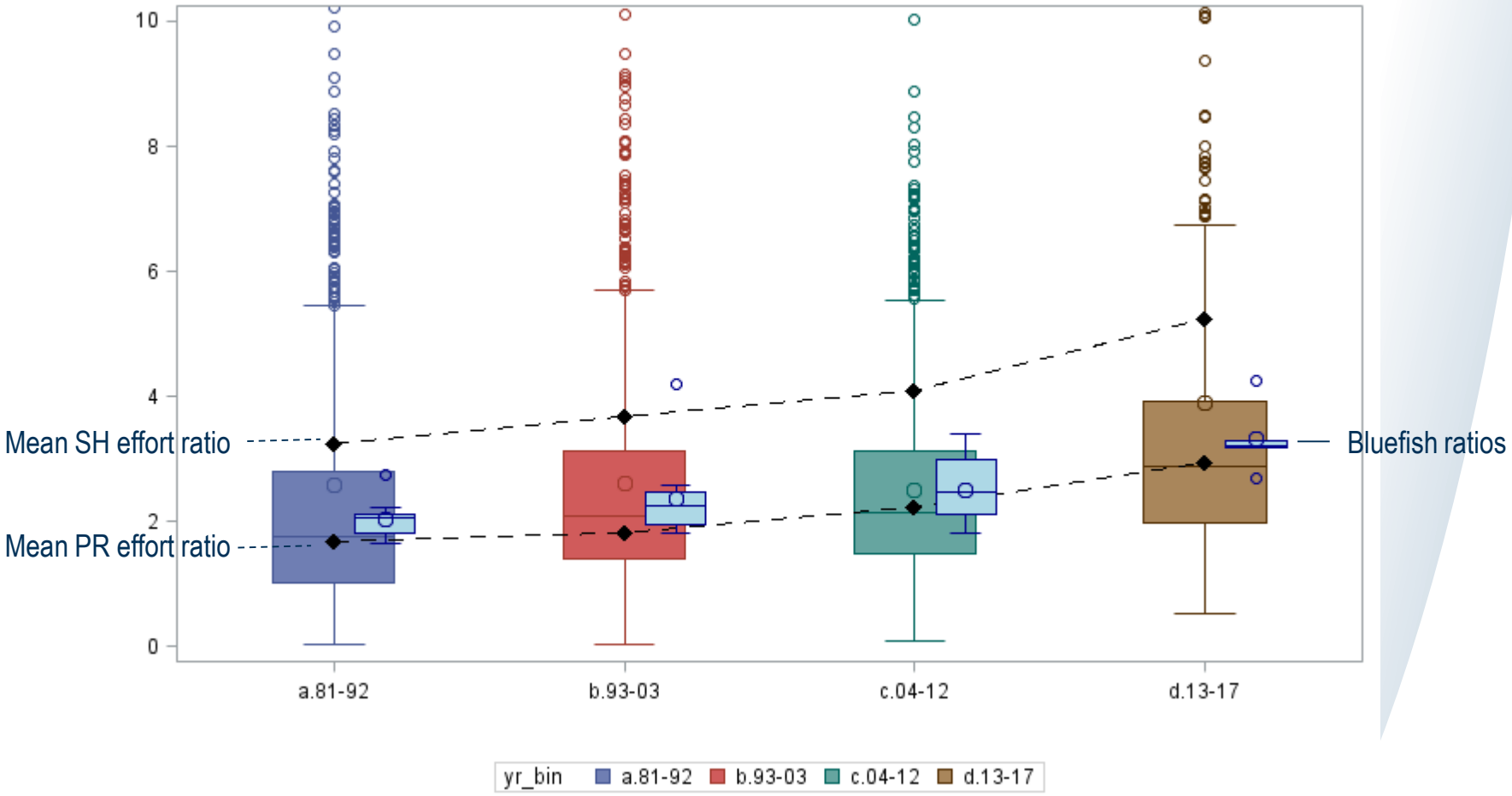
MRIP Mid-Atlantic Bluefish Total Annual Releases



Overall increase in releases, inter-annual changes similar among all estimate series, change for FCAL series in recent years. Shaded regions indicate 95% confidence interval.

MRIP Mid-Atlantic Landings Change Ratios

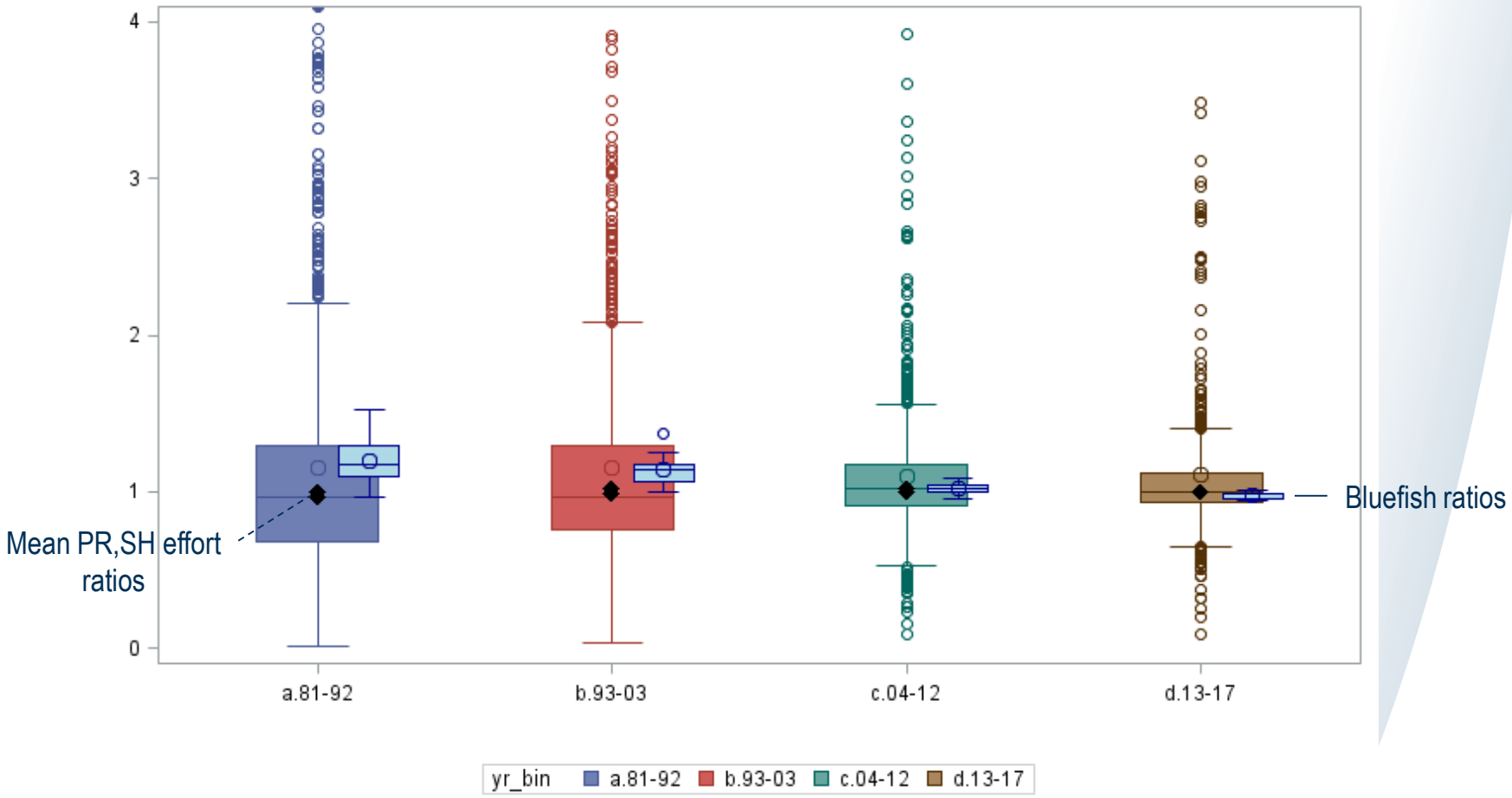
FCAL : BASE



Box plot summaries of FCAL : BASE for annual total landings (all species, bluefish) and mean ratios for SH and PR effort by year groups.

MRIP Mid-Atlantic Landings Change Ratios

ACAL : BASE



Box plot summaries of FCAL : BASE for annual total landings (all species, bluefish) and mean ratios for SH and PR effort by year groups.

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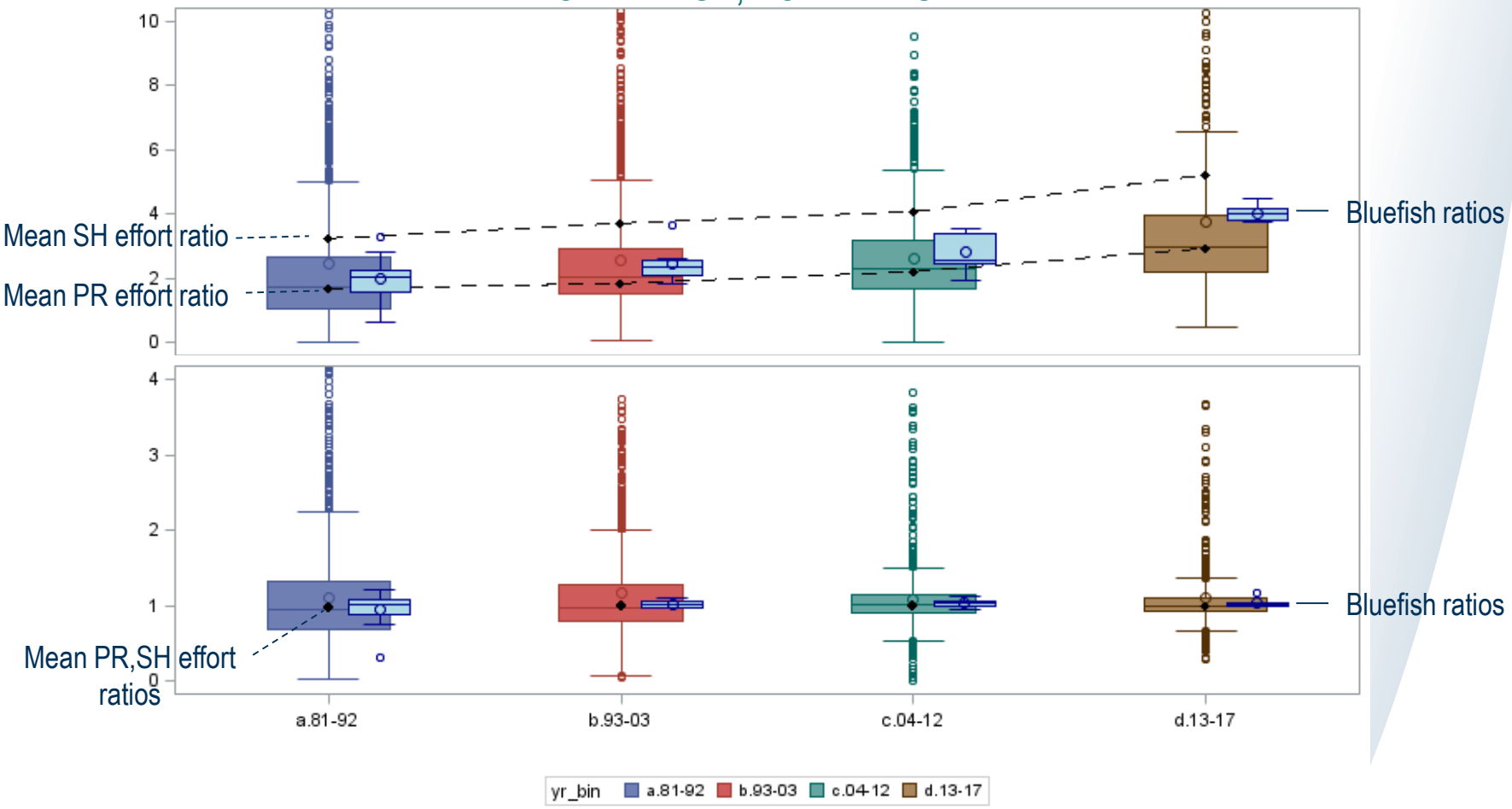
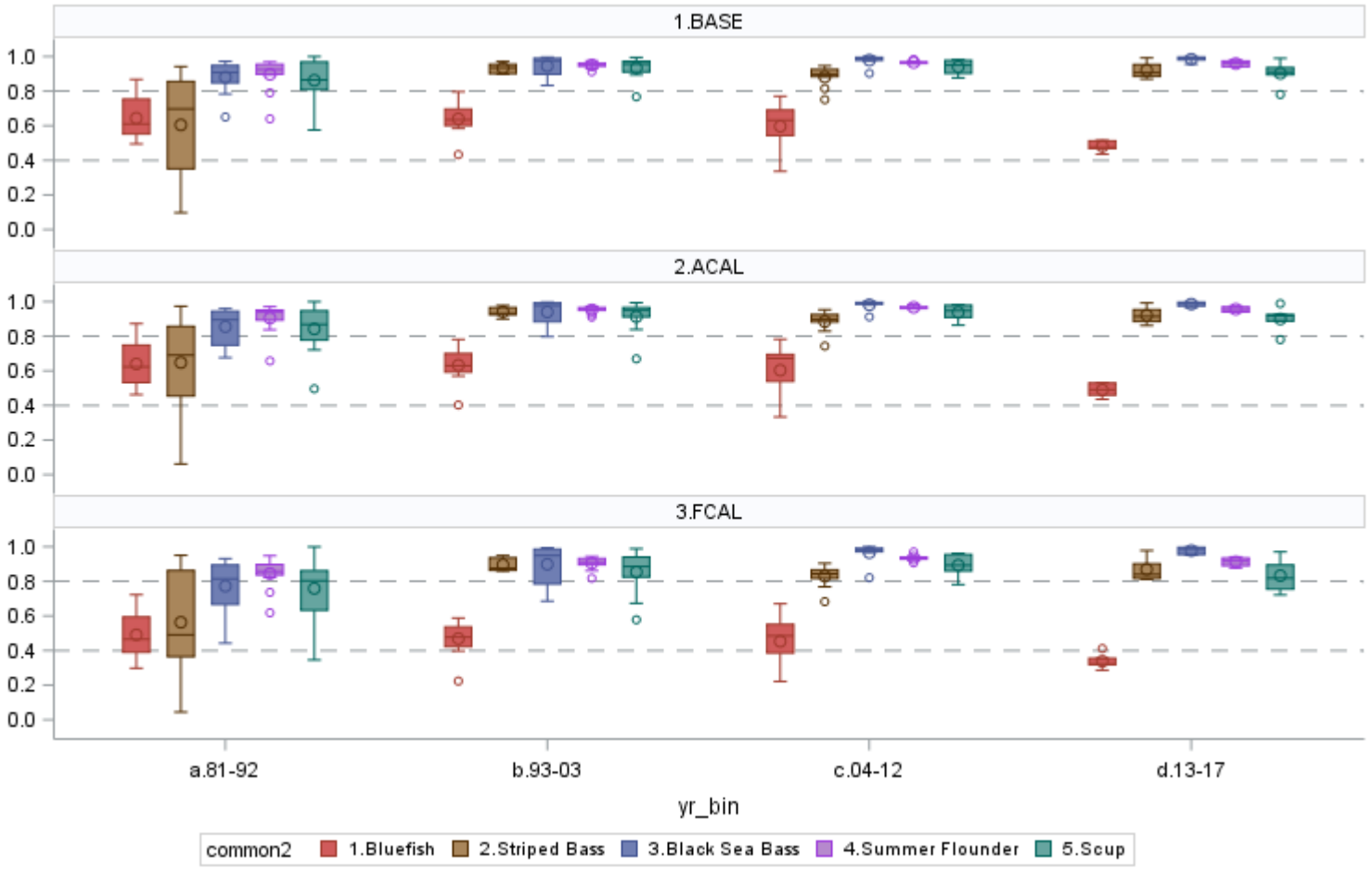
MRIP Mid-Atlantic Releases Change Ratios



Box plot summaries of FCAL : BASE, ACAL : BASE for annual total releases (all species, bluefish) and mean ratios for SH and PR effort by year groups.

MRIP PR proportion of (SH + PR) Mid-Atlantic Annual Landings



Box plot summaries of PR proportions of (SH + PR) Mid-Atlantic Annual Landings by year group and estimate series for select species.

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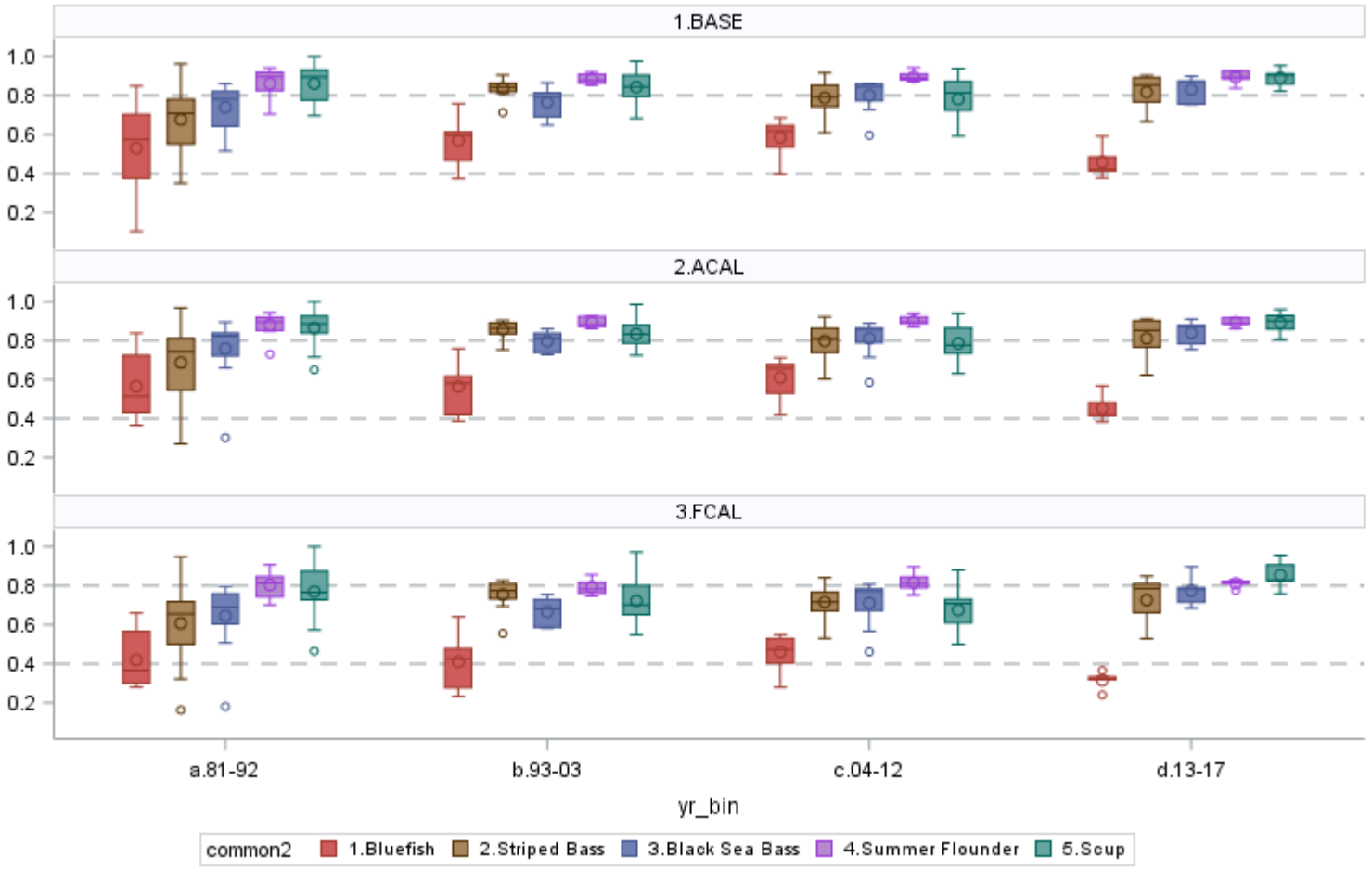
MRIP PR proportion of (SH + PR) Mid-Atlantic Annual Releases



Box plot summaries of PR proportions of (SH + PR) Mid-Atlantic Annual Releases by year group and estimate series for select species.

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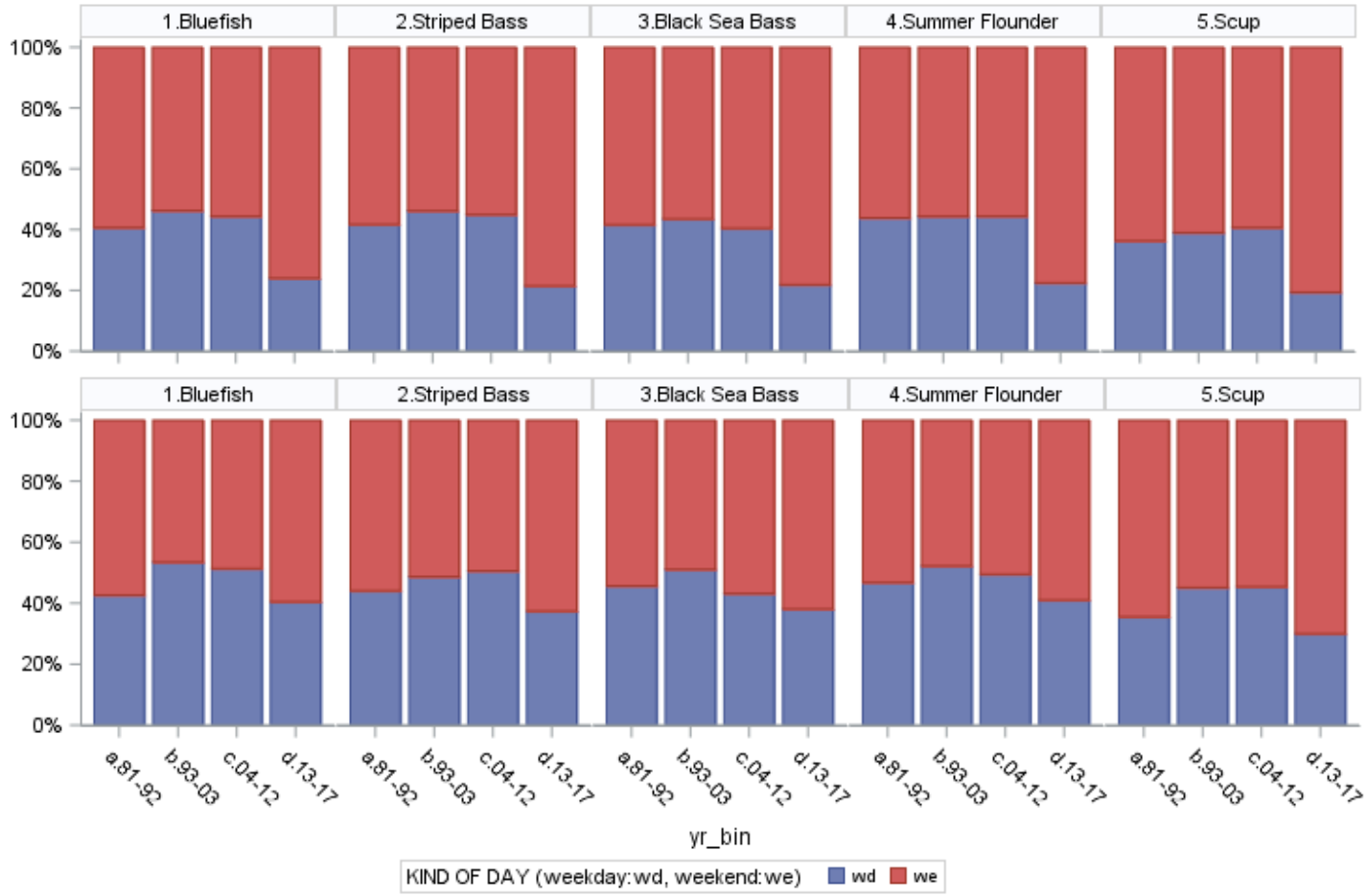
MRIP PR+SH Intercept Distributions by KOD and Species

Unweighted

Weighted



Relative distributions of Mid-Atlantic PR and SH mode APAIS intercepts by year group, species, and Kind-of-Day.

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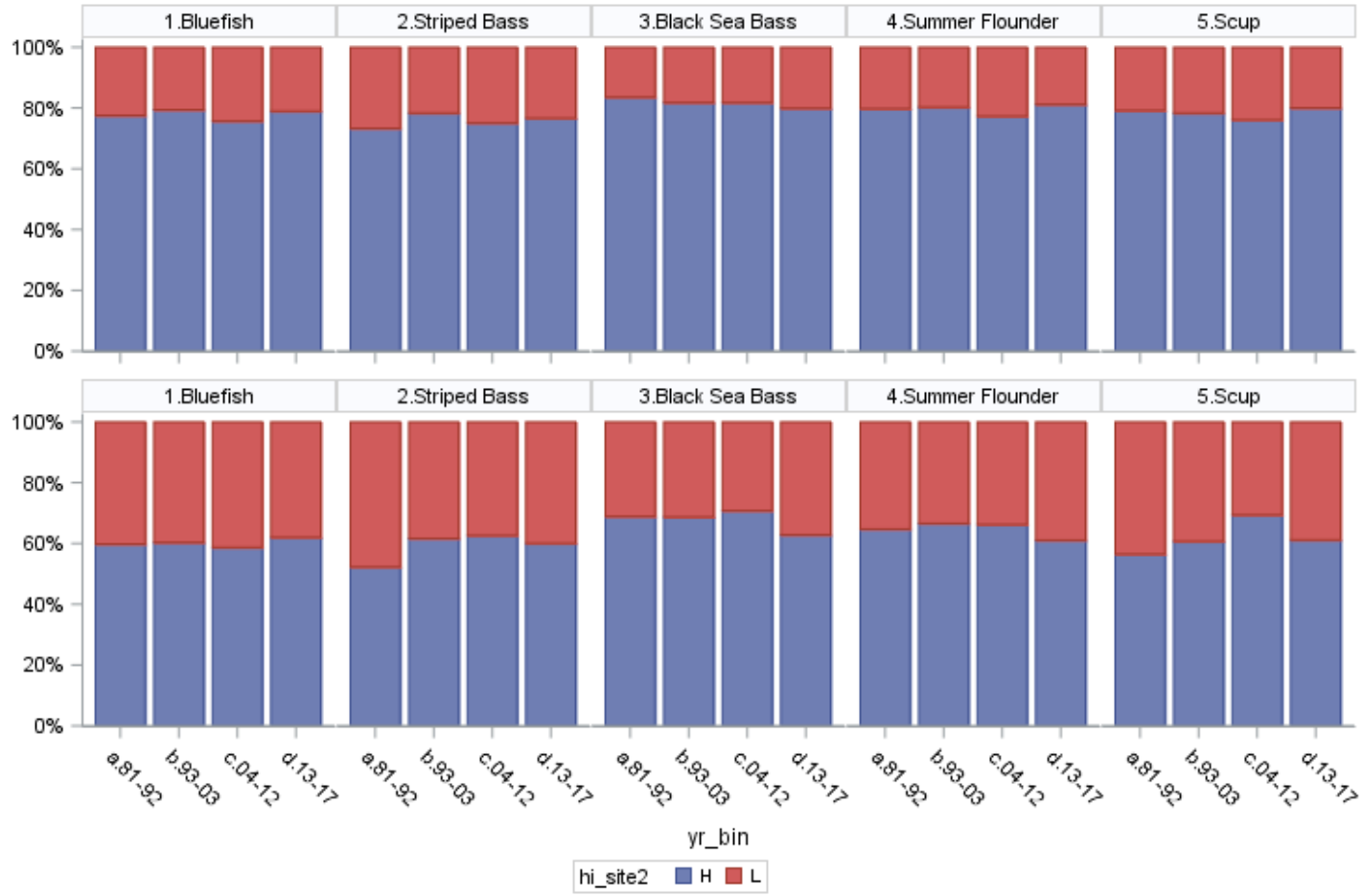
MRIP PR+SH Intercept Distributions by Site Activity, Species

Unweighted

Weighted



Relative distributions of Mid-Atlantic PR and SH mode APAIS intercepts by year group, species, and site activity level (high, low).

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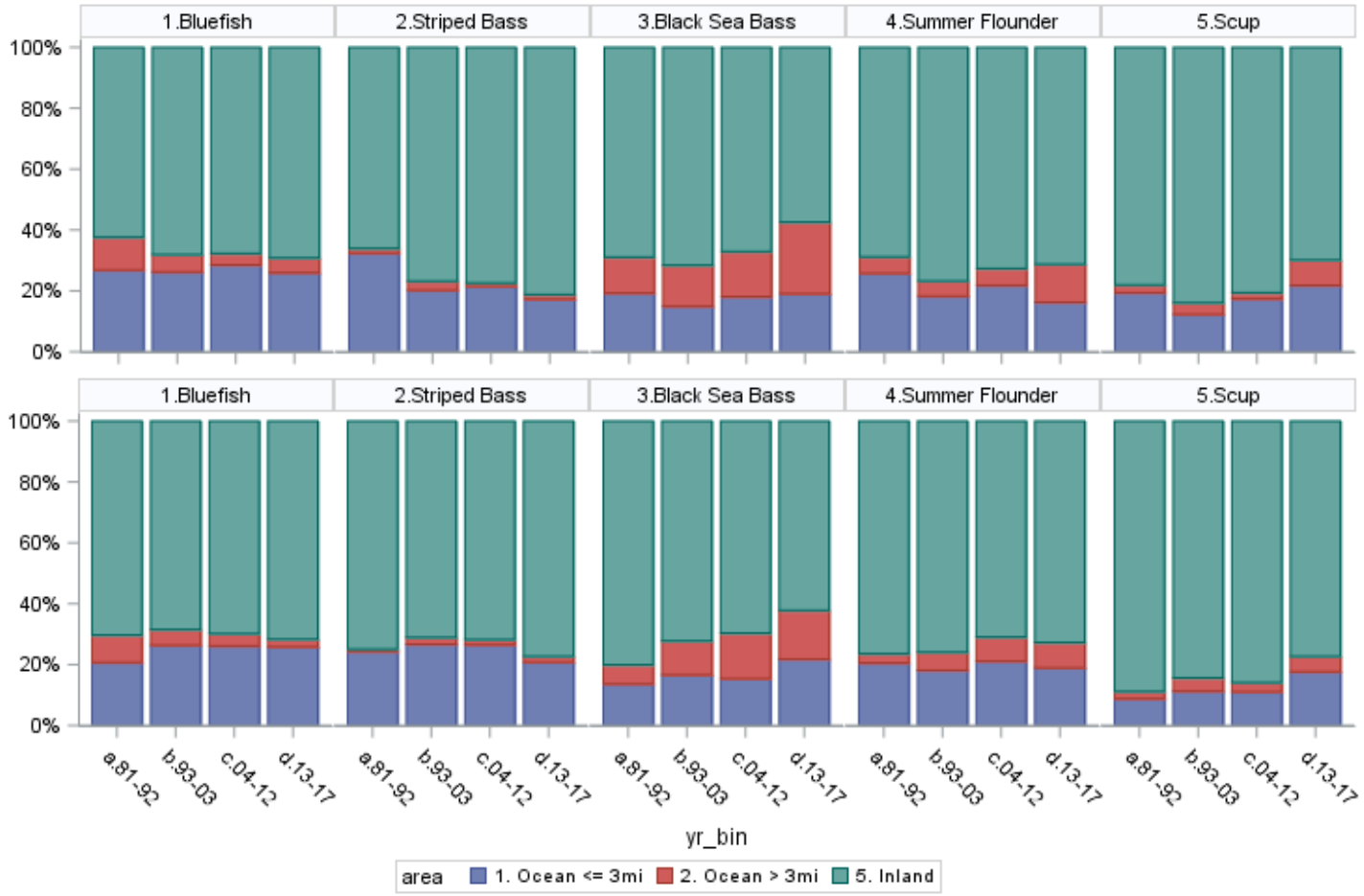
MRIP PR+SH Intercept Distributions by Area and Species

Unweighted

Weighted



Relative distributions of Mid-Atlantic PR and SH mode APAIS intercepts by year group, species, and area fished.

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Bluefish Summary

- Systematic increase in landings and releases over time series due to FES calibration
- Trends and relative year-to-year fluctuations in estimates generally similar among series with some divergence, particularly in the most recent years for the fully calibrated (FCAL) series
- Changes for bluefish catch estimates in line with overall results
- Noticeably larger component of bluefish landings from Shore mode compared to other priority species

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Effects of survey changes on MRIP estimates

With bluefish case study

Mid-Atlantic Fishery Management Council
Scientific and Statistical Committee Meeting
March 11, 2020
Baltimore, MD

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