# SEDAR 61 Gulf of Mexico Red Grouper Stock Assessment:

# Data and Assessment Workshop

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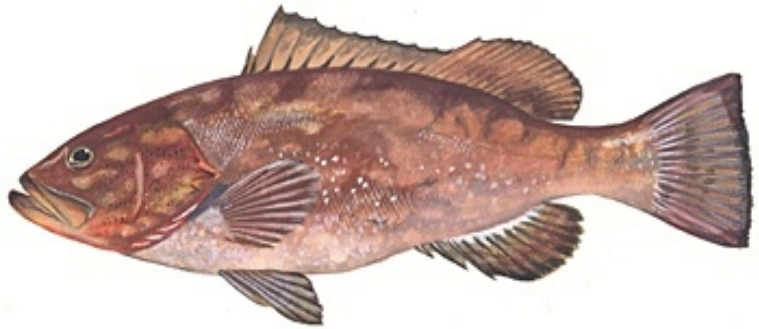
Matthew W. Smith

September 11-13, 2018

# Outline



- Review:
  - Terms of Reference
  - Continuity data sources (compare to SEDAR42)
  - New data sources
  - Continuity model structure
- Discuss:
  - Changes to data analysis
  - Areas for improvement in model

# Terms of Reference

**SEDAR 61 Gulf of Mexico Red Grouper**

**Assessment Terms of Reference**

**November 2017**

1. Update the approved SEDAR 42 Gulf of Mexico red grouper base model, with data through 2017 Provide a model consistent with the previous assessment configuration to incorporate and evaluate any changes allowed for during this assessment.

2. Evaluate and document the following specific changes in input data or deviations from the benchmark model previous assessment model.

   - Review existing methods for deriving discard numbers and discard rates and improve methods as appropriate
   - Explore the effect of the IFQ program on commercial CPUE, and the sensitivity of model results to plausible alternative commercial CPUE series
   - Review analytical methods for the combined video index from the FWRI, Pascagoula, and Panama City video surveys
   - Explore the potential effects of red tide with consideration of past red tide events and those of 2014 and 2015
   - Reconsider the start year of the assessment model
   - Evaluate size-based selectivity
   - Investigate the use of new fishery-independent hook-gear survey data collected by FWC

# Continuity Data - submitted

- **Life history**
  - Updated fecundity
- **Age composition**
  - Commercial
- **Landings**
  - Commercial
  - Headboat
- **Discards**
  - Commercial
- **Indices**
  - Commercial CPUE (unchanged)
  - Headboat CPUE
  - NMFS Bottom Longline
  - NMFS Groundfish
  - Combined Video (Panama City, NMFS, FWRI)
- **Length composition**
  - Surveys
  - Commercial discards
  - Recreational discards
- Index of red tide severity

# New Data Submitted

- Index of red tide mortality for age 0, juvenile, and adult red grouper
  - Ecosystem analysis (SEDAR61-WP-06)
- FWRI fishery-independent surveys
  - Vertical line (2014-2017)
    - Index and length composition
  - FWRI repetitive time drop (2014-2017)
    - Index and length composition
- Anecdotal information from fishermen
  - “Fishy” survey conducted by Council

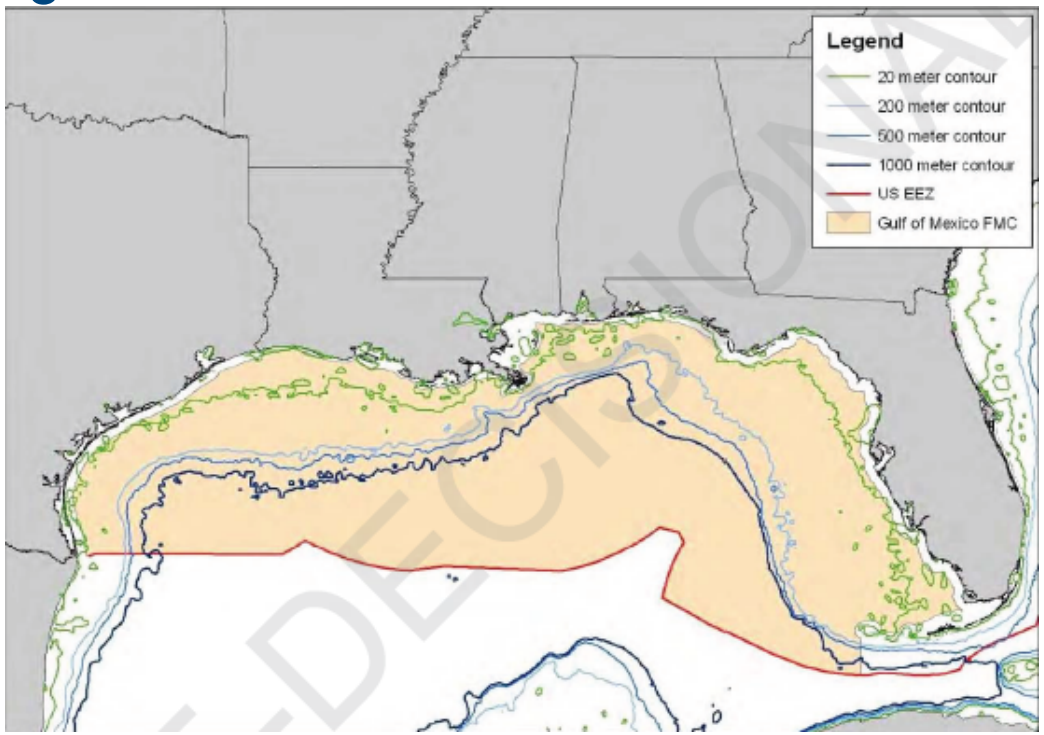
# Data Analyses Pending

- Commercial indices (post-IFQ)
- MRFSS landings
- MRFSS discards
- MRFSS index of abundance
- Headboat discards
- Recreational age composition
  - Requires recreational length composition after MRIP revisions

# General

# Stock/Management Boundary

- Gulf of Mexico stock is separated from the South Atlantic at council boundary line
  - Boundary – U.S. Highway 1 in the Florida Keys
  - Following same recommendation as SEDAR 12 & 42

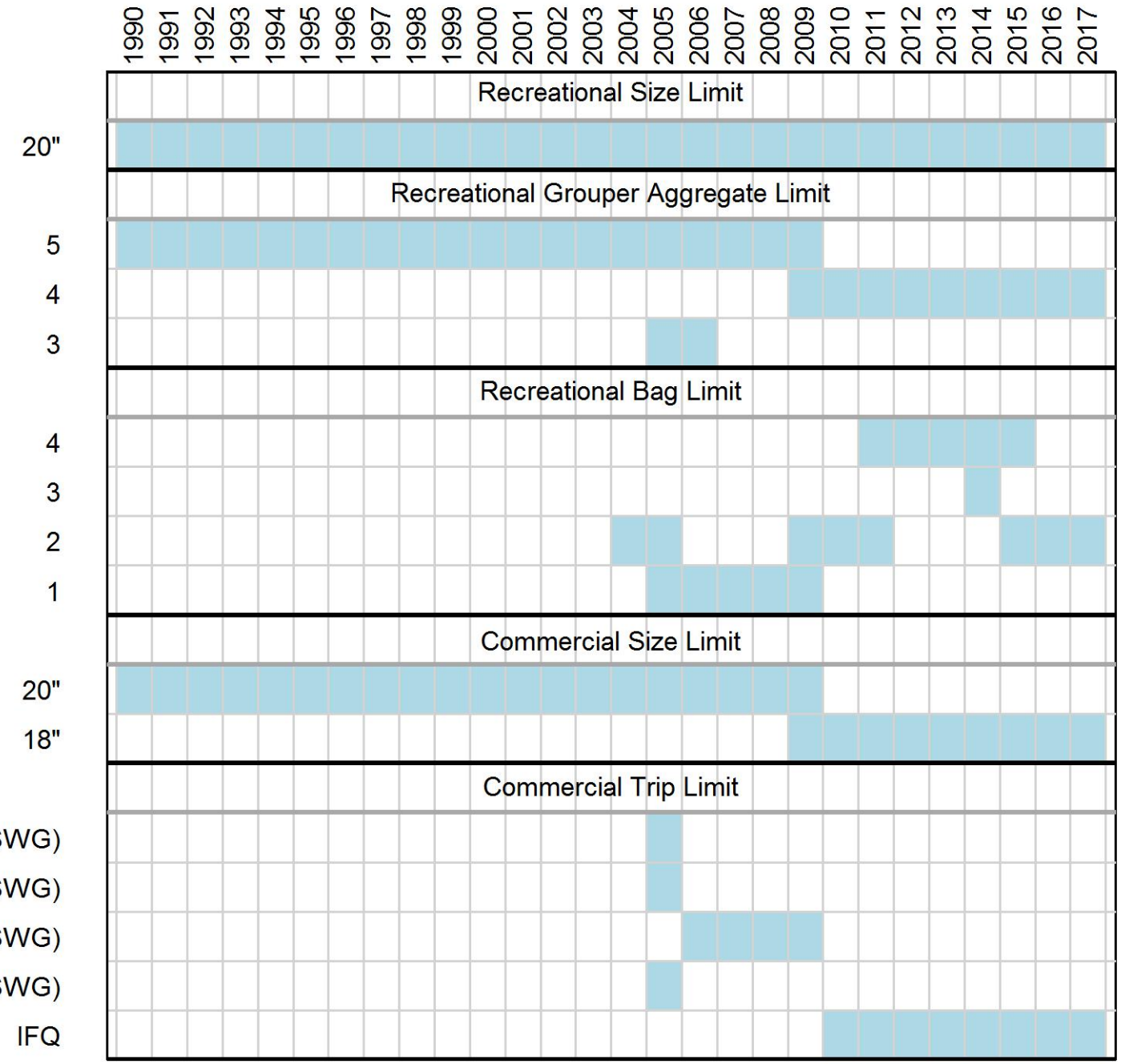


# Assessment History

| Year | Method | Overfished? | Experiencing Overfishing? |
|---|---|---|---|
| 1991 | Catch curve, per recruit analysis | No | - |
| 1993 | Virtual Population Analysis (assessment results deemed invalid) | - | - |
| 1999 | Age Structured Assessment Program (ASAP) | Yes | Yes |
| 2006 | ASAP | No | No |
| 2009 | ASAP | No | No |
| 2015 | Stock Synthesis | No | No |

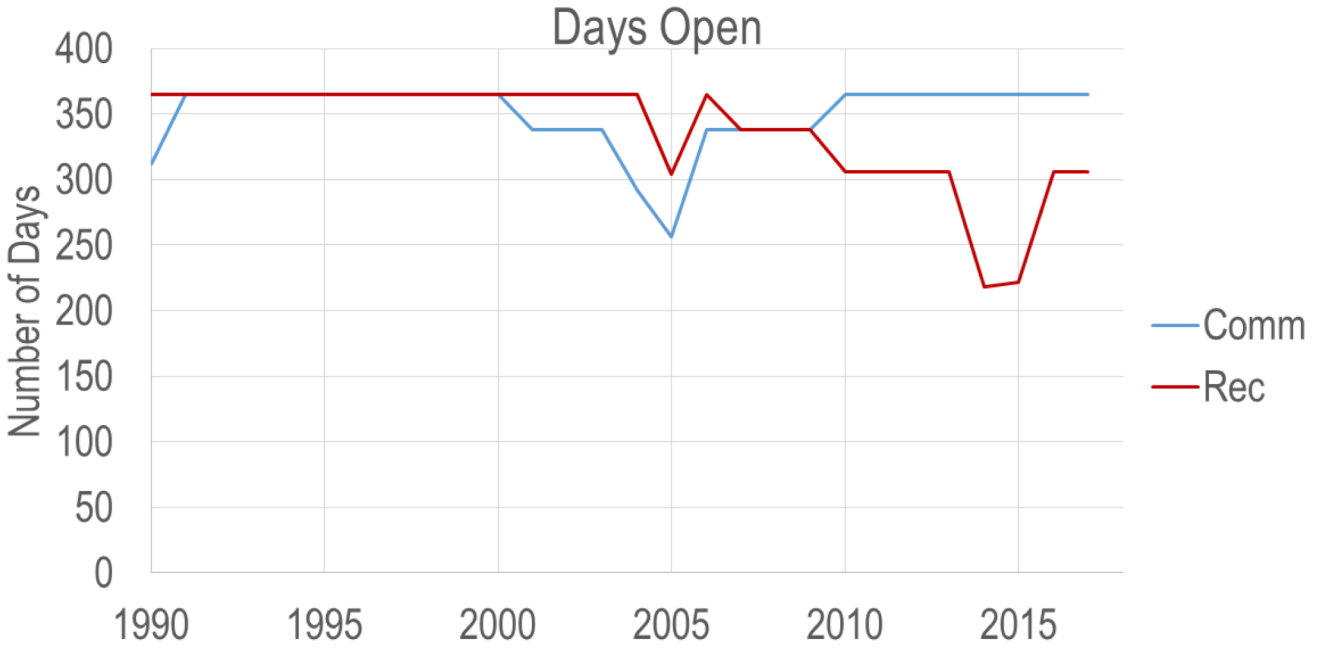
# GOM Red Grouper Regulations

Overlapping cells reflect change in year



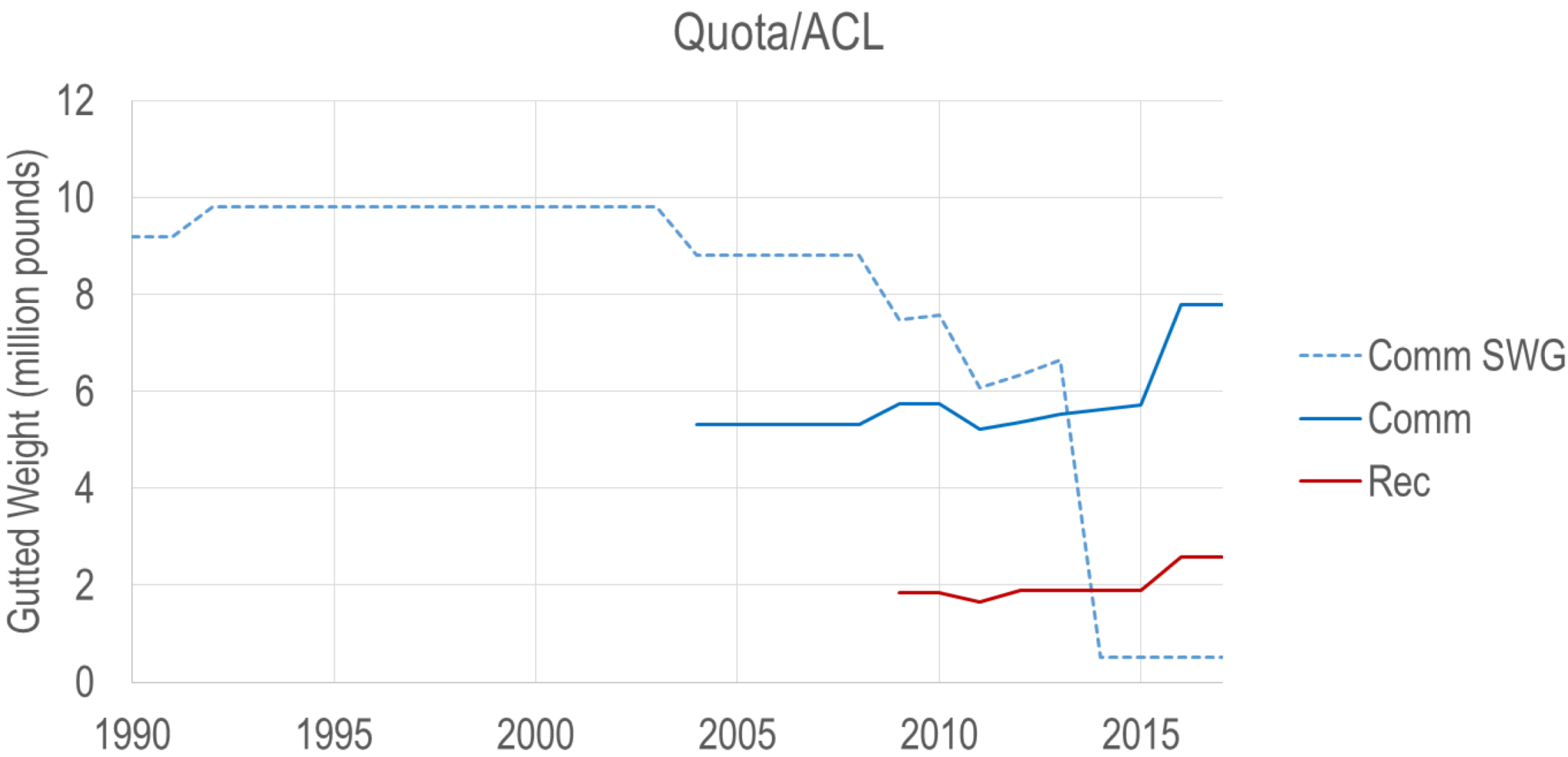
# GOM Red Grouper Regulations

## Seasonal Closures




| Effective Date | End Date | Fishery | Closure Type | First Day Closed | Last Day Closed | Region Affected | FR Reference |
|---|---|---|---|---|---|---|---|
| 6/19/2000 | 12/31/2009 | Com | Seasonal | 15-Feb | 14-Mar[1] | Gulf of Mexico EEZ | 65 FR 31827; 74 FR 44732 |
| 11/15/2004 | 12/31/2004 | Com | Quota | 15-Nov | 31-Dec | Gulf of Mexico EEZ | 69 FR 65092 |
| 10/10/2005 | 12/31/2005 | Com | Quota | 10-Oct | 31-Dec | Gulf of Mexico EEZ | 70 FR 57802 |
| 8/9/2005 | 1/23/2006 | Rec | Seasonal | 1-Nov | 31-Dec | Gulf of Mexico EEZ | 70 FR 42510 |
| 12/18/2006 | 5/17/2009 | Rec | Seasonal | 15-Feb | 14-Mar[1] | Gulf of Mexico EEZ | 71 FR 66878 |
| 5/18/2009 | 7/4/2013 | Rec | Seasonal | 1-Feb | 31-Mar | Gulf of Mexico EEZ | 74 FR 17603 |
| 7/5/2013 | Ongoing | Rec | Seasonal | 1-Feb | 31-Mar | Gulf of Mexico EEZ seaward of 20 fathoms | 78 FR 33259 |
| 9/16/2014 | 12/31/2014 | Rec | Quota | 4-Oct | 31-Dec | Gulf of Mexico EEZ | 79 FR 54668 |
| 10/8/2015 | 12/31/2015 | Rec | Quota | 8-Oct | 31-Dec | Gulf of Mexico EEZ | 80 FR 59665 |

# GOM Red Grouper Regulations



# Life History

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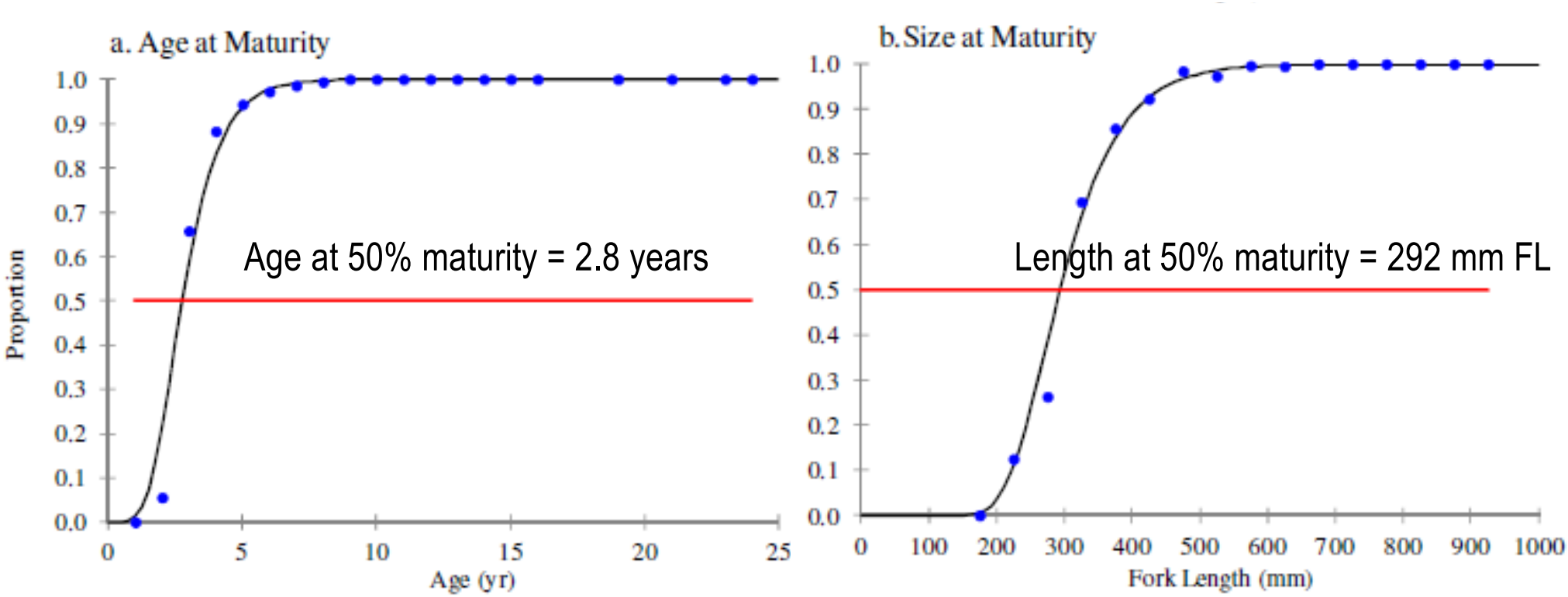
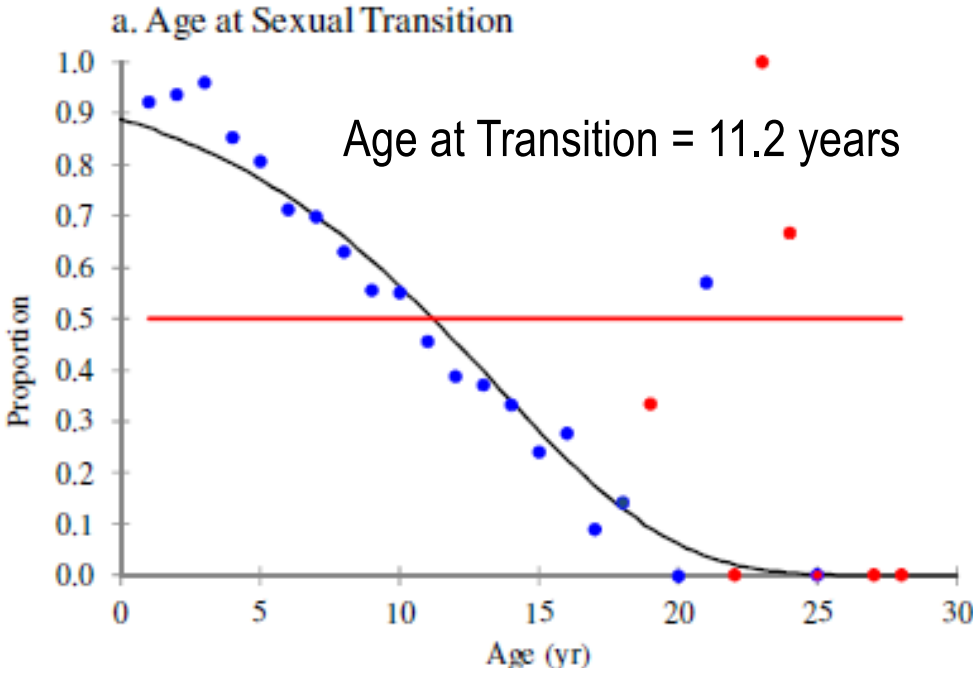
- Primarily the same as SEDAR 42
- Reproductive biology
  - Maturity
  - Hermaphroditism
    - Implicitly accounted for in fecundity*
- Age and growth*
- Meristics
- Natural mortality

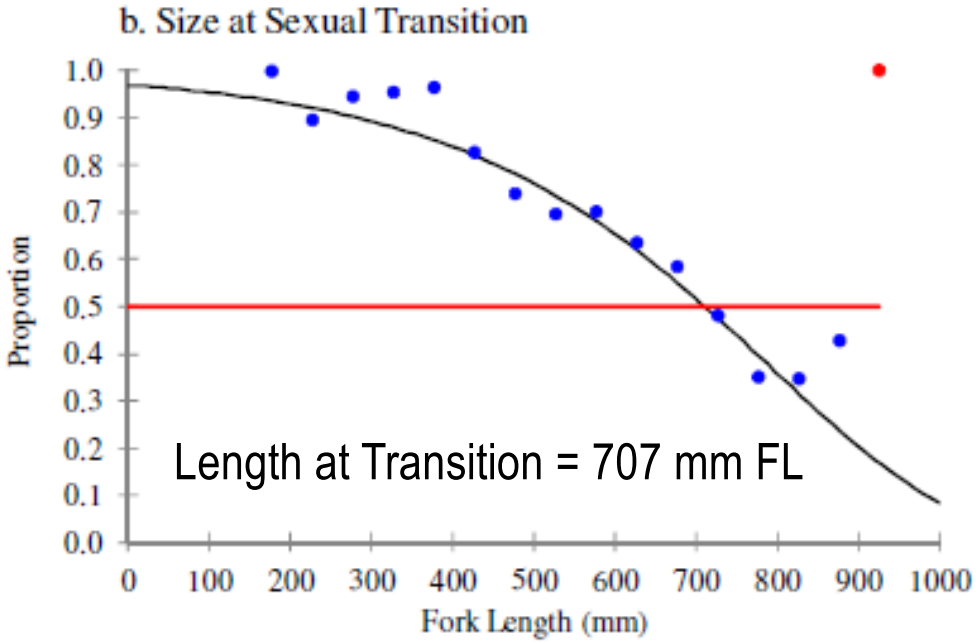
*Updated for SEDAR 61

# Age and Size at Maturity



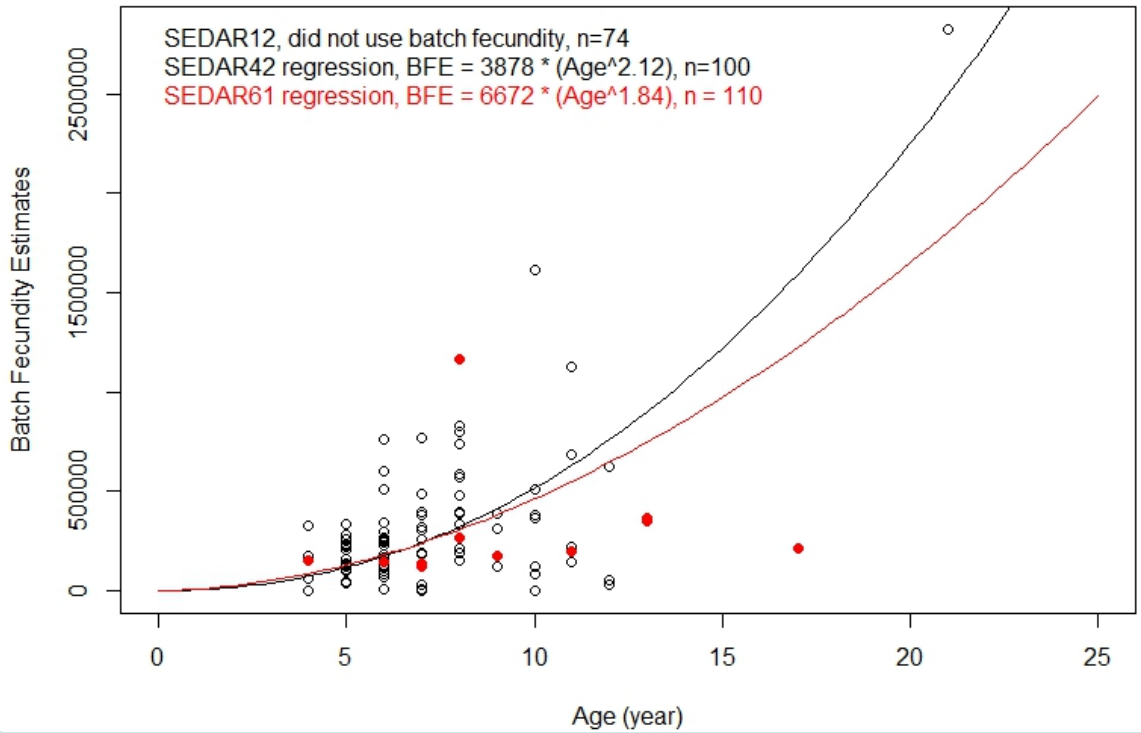
# Age and Size at Transition



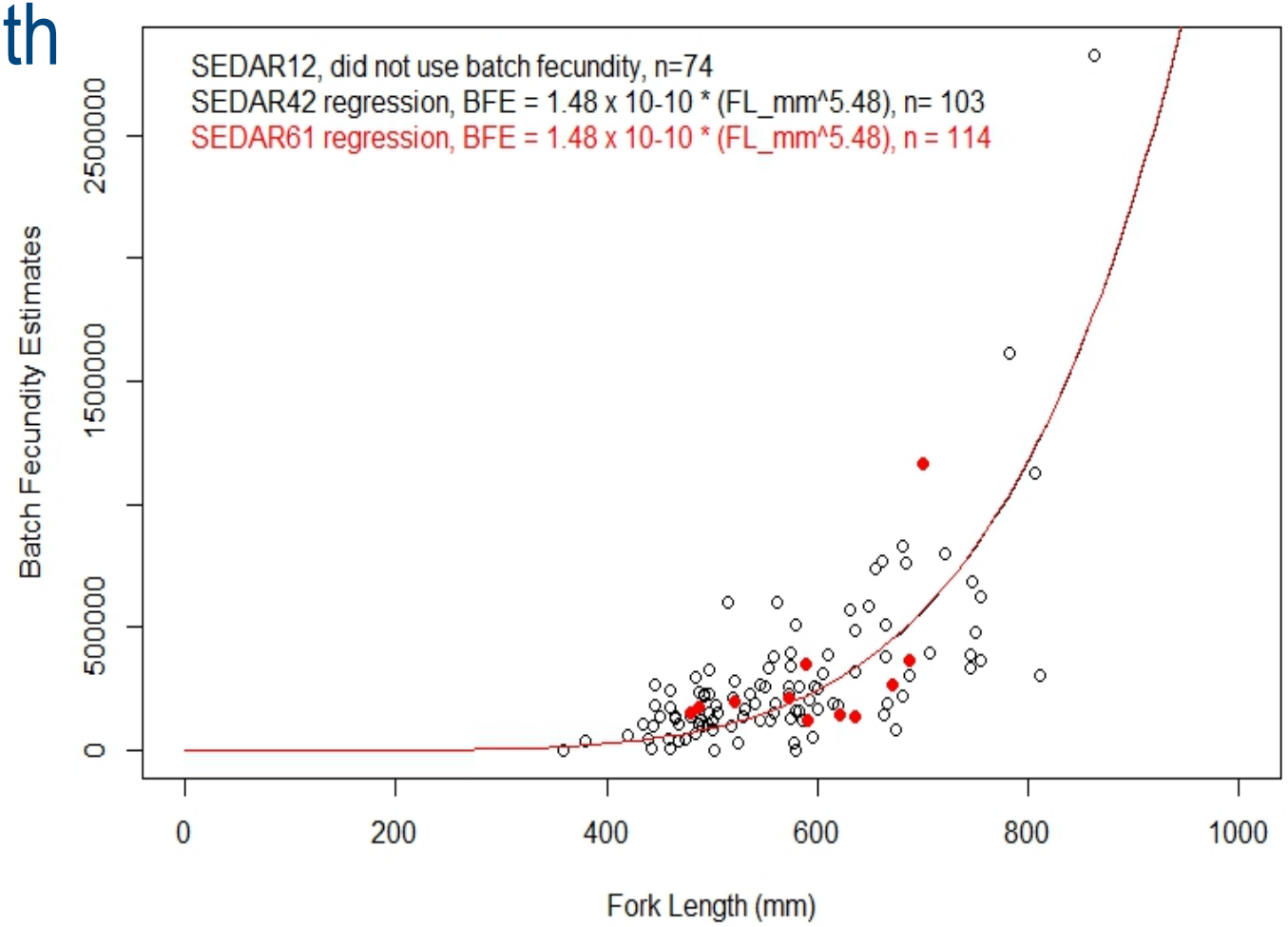
# Reproductive Biology

- SEDAR 12 and 2009 update used female ovary weight as proxy for fecundity.
- Batch fecundity recommended for use in SEDAR 42



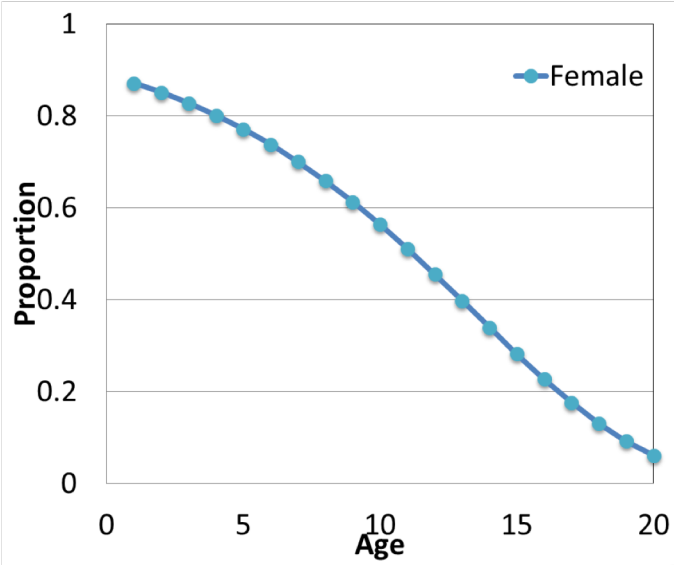
# SEDAR 61

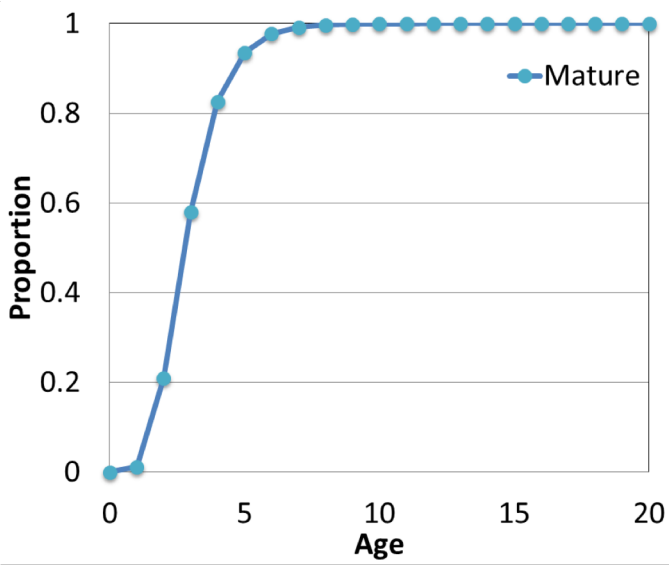
- Propose modeling batch fecundity as a function of length

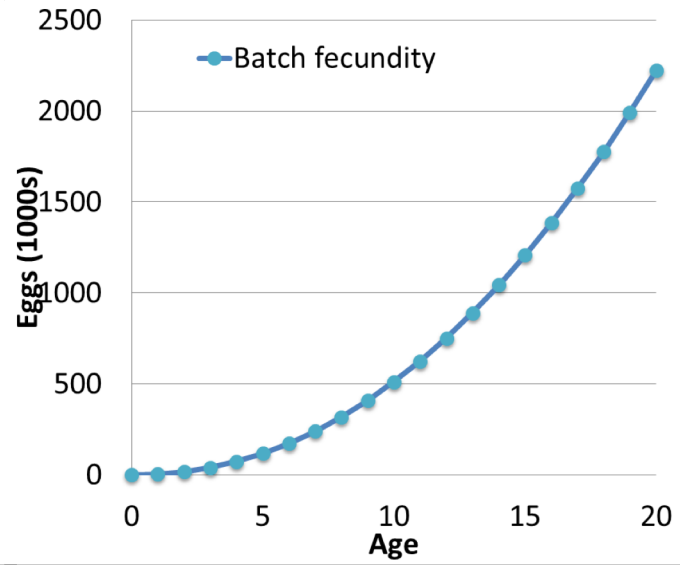


# Per Capita Fecundity =

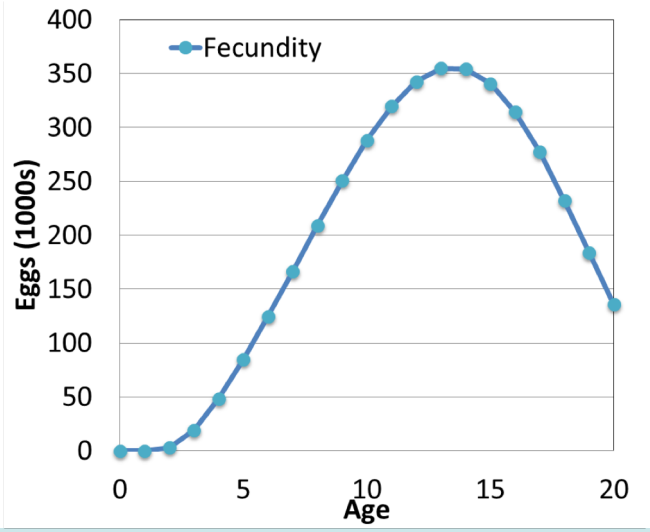
proportion female × proportion mature × batch fecundity




- Fecundity vector fixed in SS
- Female SSB in million of eggs



# SSB metric

- SEDAR 42 used female only SSB (number of eggs)
  - Greater biomass of males

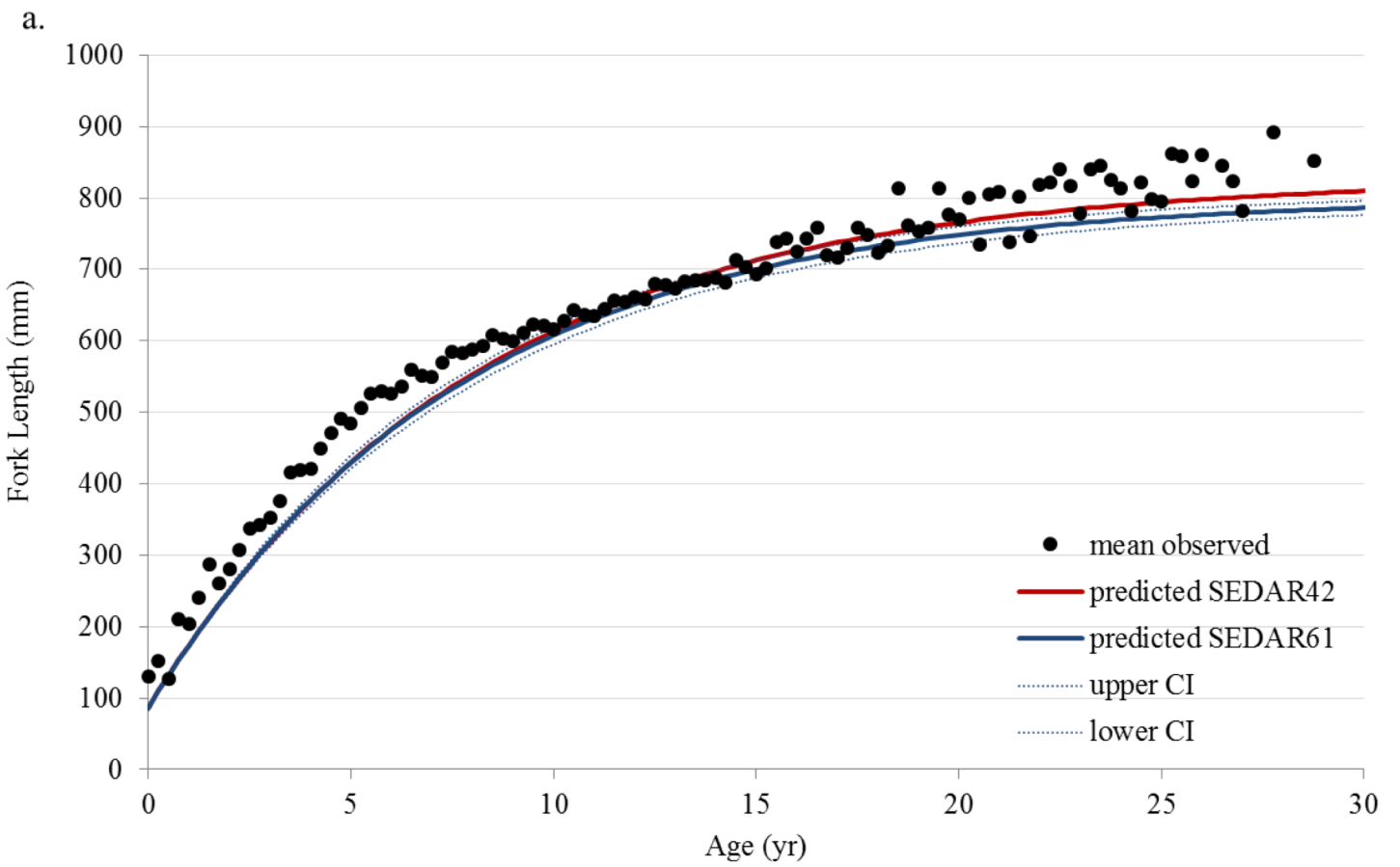
| Source | N | Males |
|---|---|---|
| FWRI 2018 | 1080 | 14% |
| NMFS 2018 | 916 | 30% |

- Male and female SSB often used for protogynous species where sperm limitation may be an issue
  - Hogfish

# Age and Growth

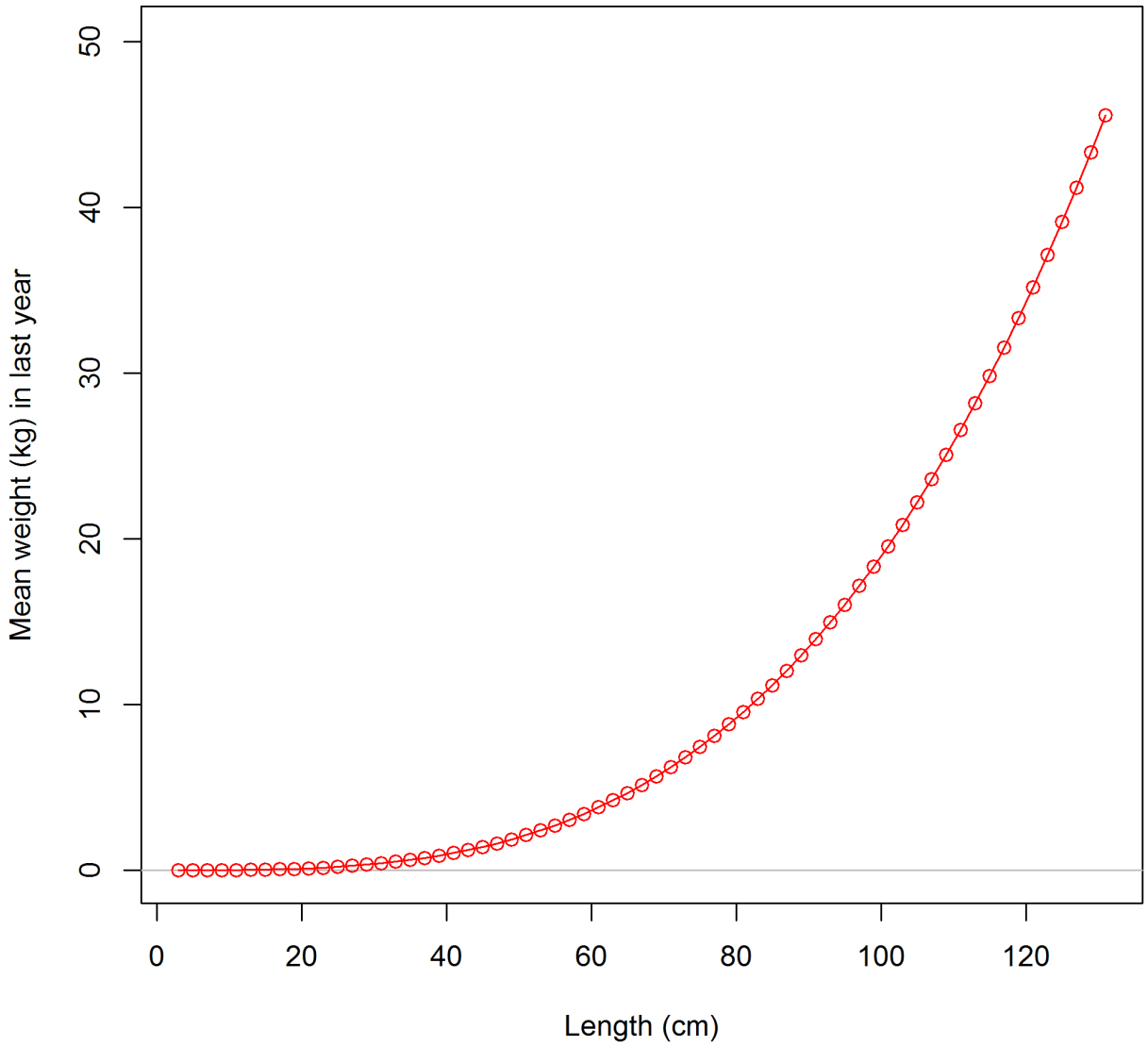
- von Bertalanffy growth model with a linearly increasing CV with length
- Updated with 8,867 new records

| Parameter | SEDAR42 | SEDAR61 |
|---|---|---|
| Linf | 82.719 | 79.995 |
| k | 0.124 | 0.131 |
| $t_0$ | -0.899 | -0.875 |



# Meristics

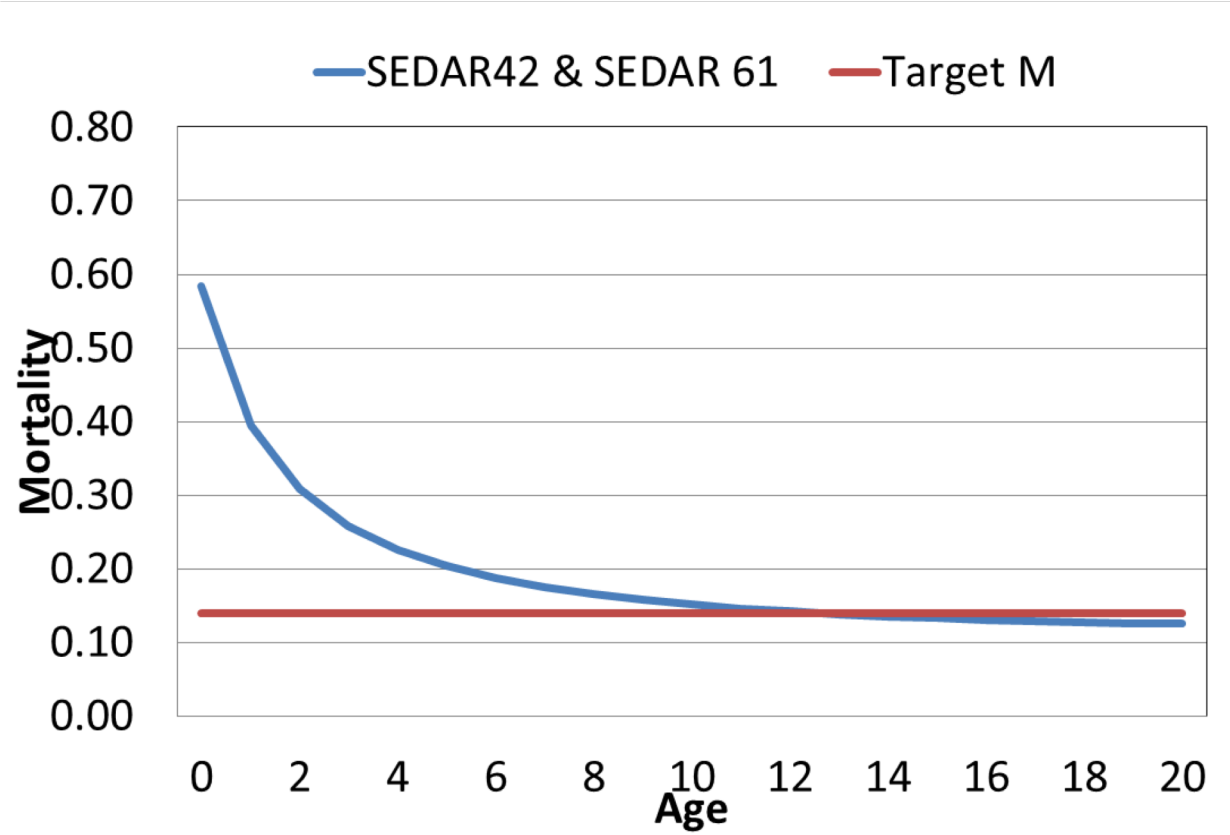
- Fishery-dependent and independent data over 1978-2013
- LW relationship fixed in assessment model




| Regression | Equation | Statistic | N | Data Range |
|---|---|---|---|---|
| Max TL to FL | FL = 5.35 + max_TL *0.95 | $r^2$=0.9963 | 5818 | Max TL: 120 – 954; FL: 116 – 910 |
| Nat TL to FL | FL = 5.71 + nat_TL * 0.95 | $r^2$=0.9909 | 3901 | Nat TL: 151 – 957; FL: 149 – 910 |
| FL to G Wt | GWT= 3.37 $10^{-09}$ * (FL^3.25) | RSE = 0.3499 | 37,414 | FL: 230 – 935; G WT: 0.26 – 16.96 |

# Natural Mortality

- Function of age using the Lorenzen (2005) estimator
  - Adjusted to account for May 15 peak spawning period
  - Target M = 0.14 based on max age of 29 (Hoenig 1983)
  - Fixed vector in SS

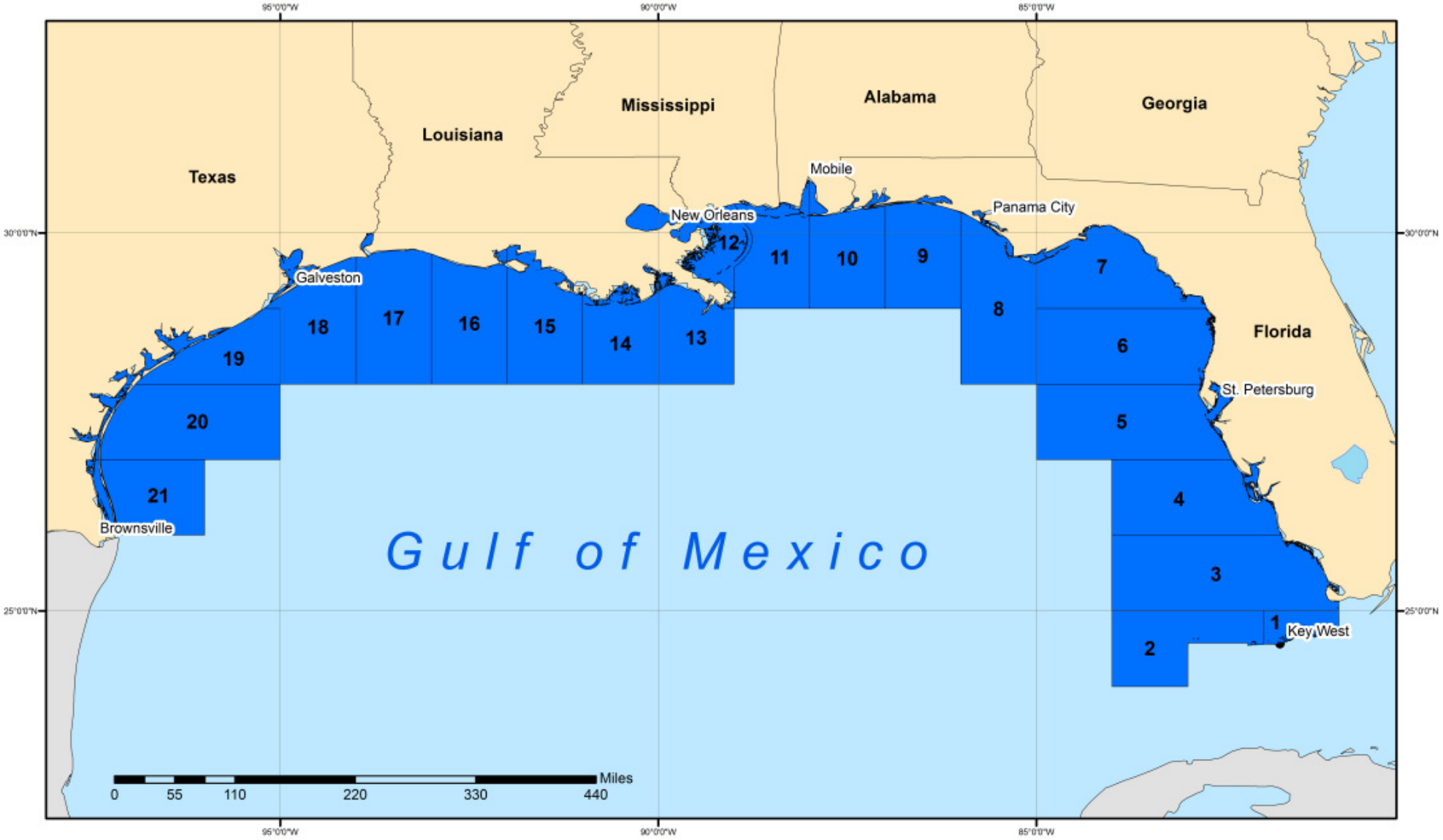


# Age composition

# Age Data Sources

- Data sources
  - Commercial fleets (1991-2017)
    - Trip Interview Program (TIP)
      - Trap (1991-2006)
      - Vertical line (1991-2017)
      - Longline (1991-2017)

# North (grids ≥ 6) vs South (grids < 6)



# Comparison of Age Composition

- Comparison to SEDAR 42 [difference in proportions]
- Difference = SEDAR 61 value – SEDAR 42 value
- Example:

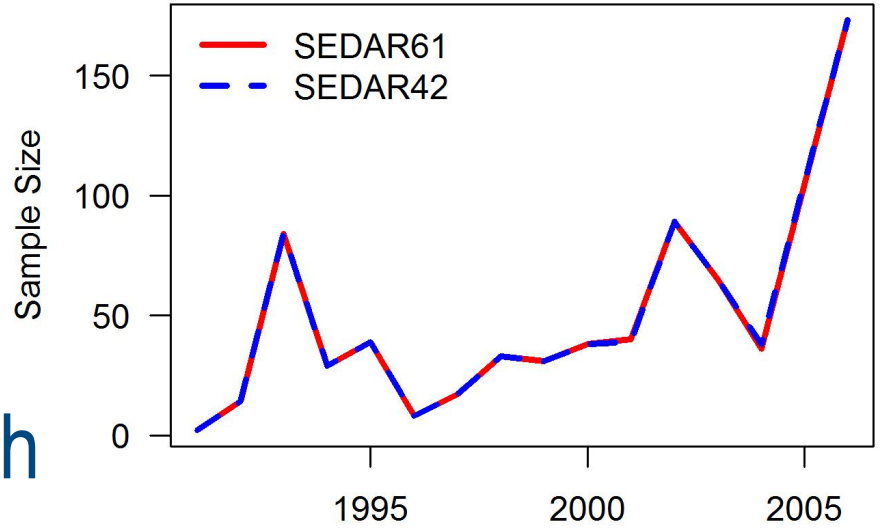
| Year | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1991 | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | -0.002 |
| 1992 | 0.000 | 0.000 | 0.000 | 0.000 | 0.294 | -0.294 |
| 1993 | 0.000 | 0.000 | 0.000 | -0.006 | -0.002 | -0.002 |

Red = SEDAR 61 higher

Blue = SEDAR 42 higher

# Age Composition – Trap 1991-2006

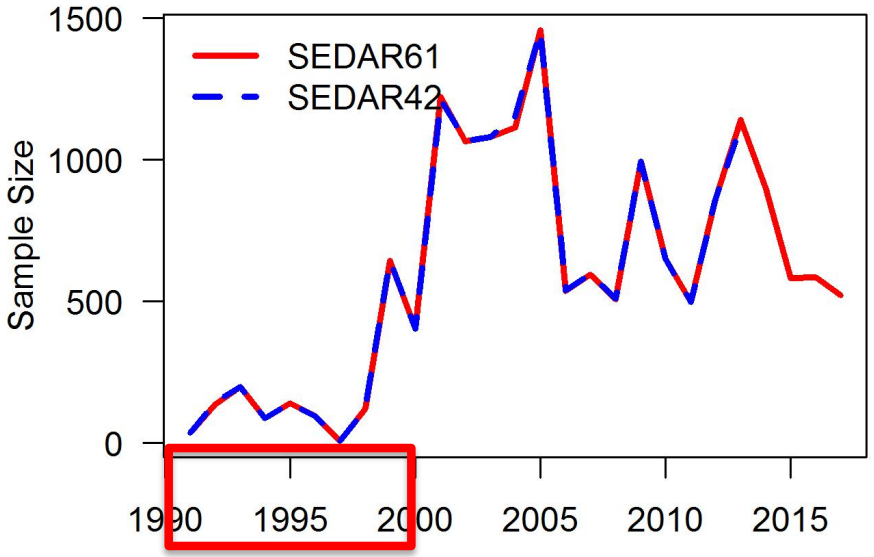
- Small sample sizes precluded stratification into North and South




| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1992 | 0.000 | 0.000 | 0.000 | 0.000 | 0.294 | -0.294 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1993 | 0.000 | 0.000 | 0.000 | -0.006 | -0.002 | -0.002 | 0.014 | -0.002 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1994 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.028 | 0.075 | -0.209 | -0.100 | 0.238 | 0.024 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1995 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.017 | 0.000 | -0.050 | 0.033 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1996 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.013 | 0.001 | 0.006 | -0.023 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1997 | 0.000 | 0.000 | 0.000 | 0.041 | -0.041 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1998 | 0.000 | 0.000 | -0.005 | 0.032 | -0.005 | -0.002 | -0.017 | 0.003 | -0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1999 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.006 | 0.000 | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | -0.006 | 0.000 | 0.000 | 0.000 |
| 2002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2004 | 0.000 | 0.000 | 0.000 | 0.002 | 0.005 | 0.001 | -0.007 | -0.017 | 0.000 | 0.013 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# Age Composition – Longline 1991-1999

- Small sample sizes precluded stratification into North and South

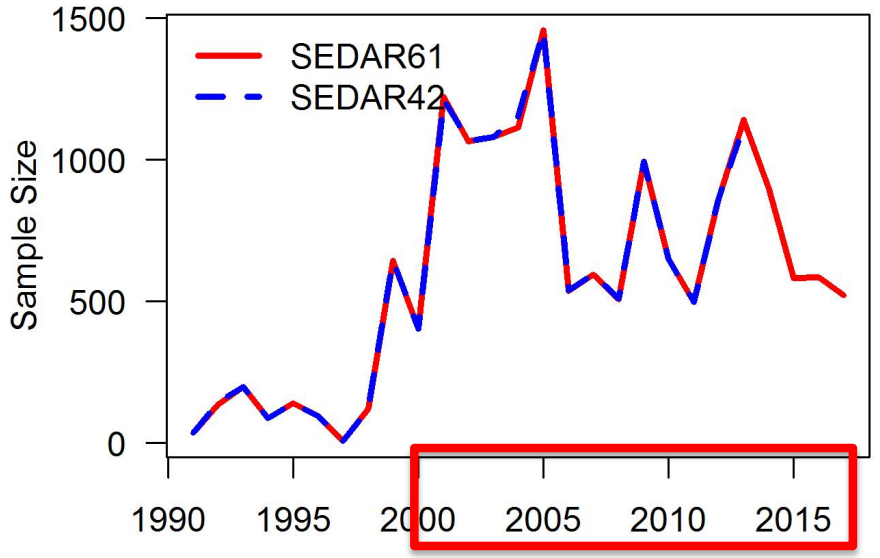



| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1992 | 0.000 | 0.000 | 0.000 | 0.000 | -0.012 | -0.002 | -0.005 | 0.011 | 0.005 | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1993 | 0.000 | 0.000 | 0.010 | 0.007 | 0.008 | 0.015 | -0.014 | -0.004 | -0.021 | 0.002 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1994 | 0.000 | 0.000 | 0.000 | 0.000 | -0.017 | 0.017 | -0.012 | 0.017 | -0.004 | -0.003 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| 1995 | 0.000 | 0.000 | 0.000 | -0.001 | 0.011 | -0.001 | -0.006 | -0.004 | -0.003 | 0.007 | 0.000 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1996 | 0.000 | 0.000 | 0.000 | -0.002 | -0.010 | -0.006 | 0.020 | 0.001 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1997 | 0.000 | 0.000 | 0.452 | -0.371 | -0.022 | -0.058 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1998 | 0.000 | 0.000 | 0.000 | -0.012 | 0.016 | 0.003 | -0.007 | -0.002 | -0.006 | 0.011 | -0.009 | -0.002 | 0.006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1999 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

- 1991, 1992, 1997 not included in SEDAR 42

# Age Composition – Longline 2000-2013

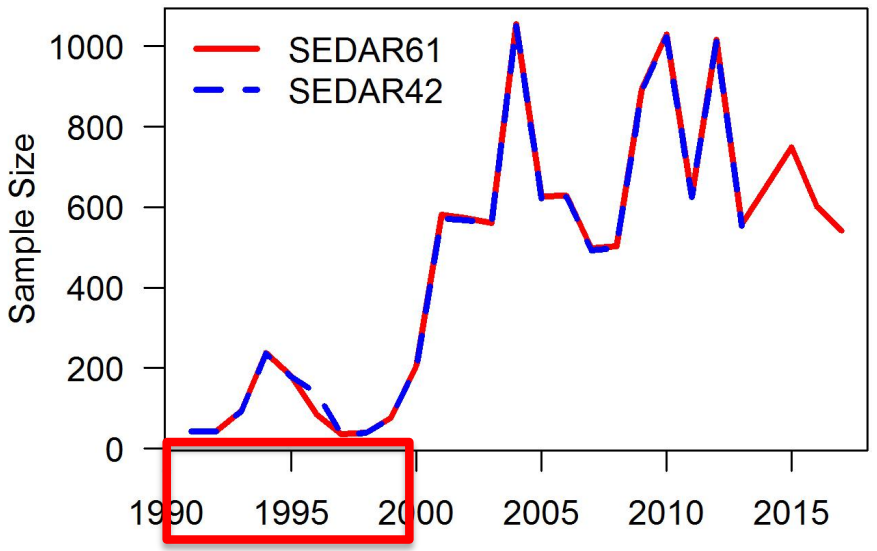
- Sample sizes allowed stratification into North and South




| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2000 | 0.000 | 0.000 | 0.000 | 0.024 | 0.002 | -0.001 | -0.009 | -0.013 | 0.004 | -0.002 | -0.007 | -0.009 | 0.013 | 0.002 | -0.003 | -0.002 | 0.003 | 0.000 | -0.001 | -0.001 |
| 2001 | 0.000 | 0.000 | 0.000 | 0.002 | 0.059 | -0.003 | -0.017 | -0.013 | -0.005 | -0.002 | -0.009 | -0.006 | -0.001 | -0.001 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2002 | 0.000 | 0.000 | 0.000 | 0.001 | 0.008 | 0.041 | 0.004 | -0.013 | -0.016 | -0.006 | -0.004 | -0.008 | -0.002 | -0.003 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| 2003 | 0.000 | 0.000 | 0.000 | 0.002 | 0.005 | 0.014 | 0.013 | -0.010 | -0.005 | -0.007 | -0.006 | 0.000 | -0.002 | -0.002 | -0.001 | 0.000 | -0.001 | 0.000 | 0.000 | 0.001 |
| 2004 | 0.000 | 0.000 | 0.000 | 0.003 | 0.035 | 0.001 | -0.004 | -0.001 | -0.010 | -0.007 | -0.003 | -0.006 | -0.003 | -0.002 | -0.002 | 0.000 | -0.001 | 0.000 | -0.001 | -0.001 |
| 2005 | 0.000 | 0.000 | 0.000 | -0.001 | -0.006 | 0.035 | -0.001 | -0.007 | -0.004 | -0.009 | -0.002 | 0.000 | -0.001 | -0.001 | -0.002 | 0.000 | -0.001 | 0.000 | 0.000 | -0.001 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.001 | -0.002 | 0.009 | 0.056 | -0.018 | -0.018 | -0.013 | -0.003 | -0.002 | -0.002 | -0.004 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | 0.000 | 0.000 | 0.000 | -0.001 | 0.010 | 0.008 | 0.021 | 0.027 | -0.020 | -0.003 | -0.017 | -0.004 | -0.006 | -0.009 | -0.003 | -0.001 | -0.001 | -0.001 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.021 | 0.007 | -0.019 | 0.006 | 0.003 | -0.007 | -0.004 | -0.003 | -0.002 | -0.001 | -0.001 | -0.001 | -0.001 | 0.001 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | -0.001 | 0.002 | 0.008 | 0.060 | -0.021 | -0.010 | -0.017 | -0.010 | -0.002 | -0.004 | -0.004 | 0.005 | -0.002 | -0.001 | 0.000 | -0.001 | -0.002 |
| 2010 | 0.000 | 0.000 | 0.000 | -0.003 | 0.001 | -0.005 | -0.003 | 0.030 | -0.001 | -0.013 | -0.007 | 0.001 | 0.003 | -0.001 | -0.001 | -0.001 | 0.000 | 0.000 | -0.001 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | -0.004 | -0.013 | -0.006 | -0.007 | -0.006 | -0.006 | -0.002 | -0.002 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.041 | -0.007 | -0.009 | -0.011 | -0.003 | -0.004 | -0.003 | -0.001 | 0.001 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | -0.009 | -0.024 | 0.036 | 0.002 | -0.008 | 0.001 | -0.001 | 0.005 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# Age Composition – Vertical line 1991-1999

- Small sample sizes precluded stratification into North and South

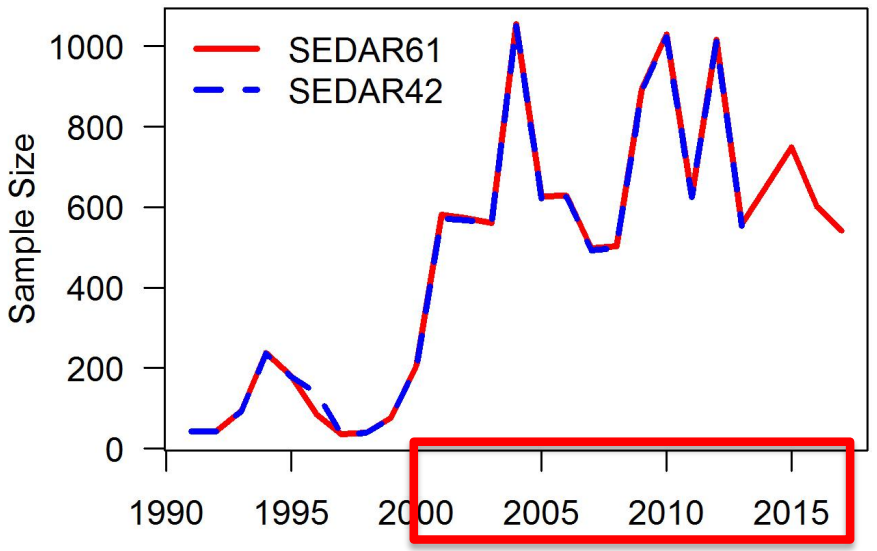



| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | -0.006 | -0.001 | 0.002 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |
| 1992 | 0.000 | 0.000 | 0.000 | 0.000 | 0.081 | -0.025 | -0.061 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1993 | 0.000 | 0.000 | 0.000 | -0.001 | 0.004 | 0.000 | 0.000 | -0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1994 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1995 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1996 | 0.000 | 0.000 | 0.000 | -0.002 | -0.013 | 0.007 | 0.004 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1997 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1998 | 0.000 | 0.000 | 0.006 | -0.006 | 0.012 | -0.012 | -0.006 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1999 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

- 1991 and 1992 not included in SEDAR 42

# Age Composition – Vertical line 2000-2013

- Small sample sizes allowed stratification into North and South



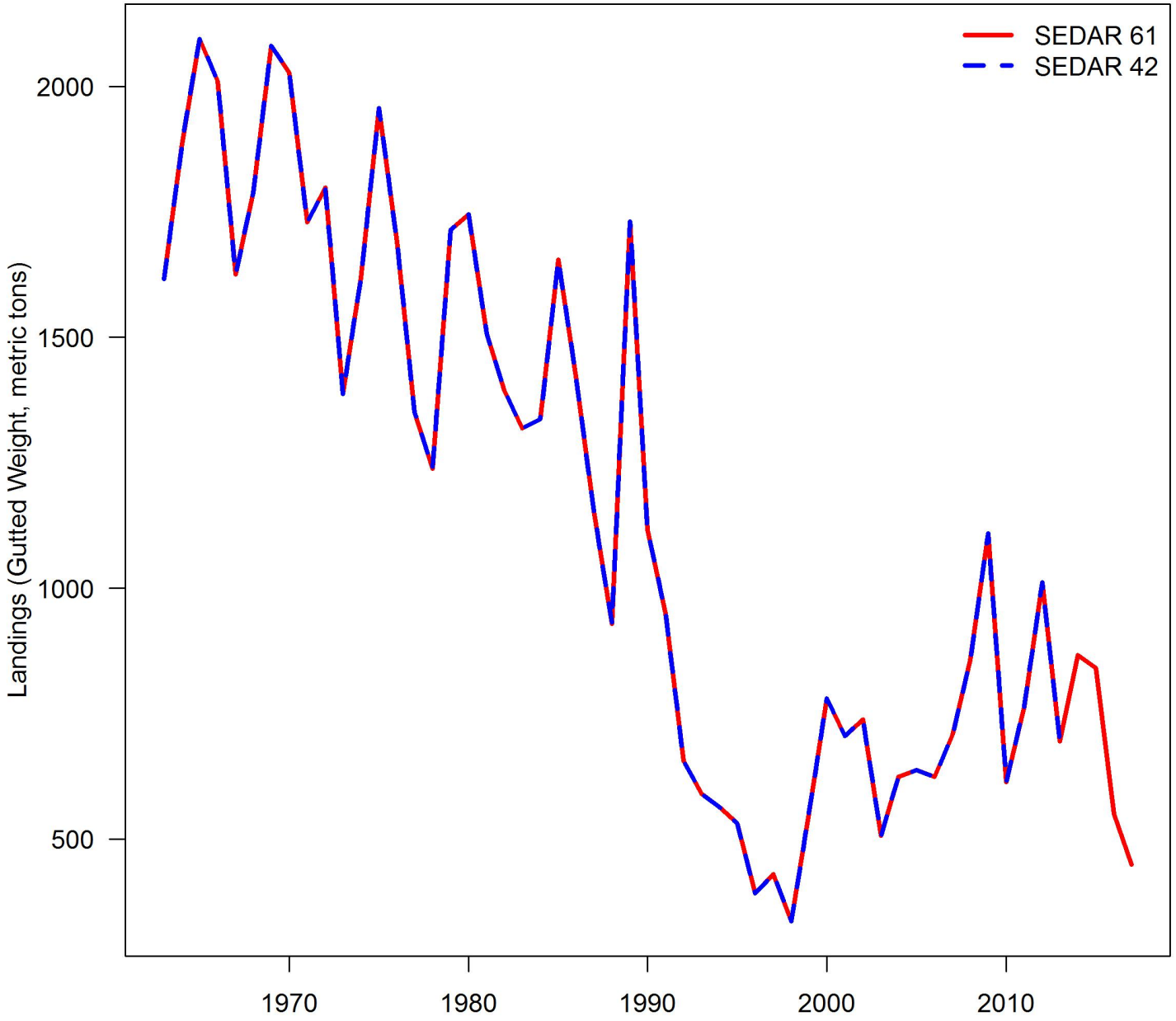

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.004 | 0.004 | -0.015 | 0.015 | -0.009 | 0.009 | 0.000 | -0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.002 | -0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2003 | 0.000 | 0.000 | 0.000 | -0.006 | 0.005 | 0.004 | 0.003 | -0.005 | 0.003 | -0.002 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |
| 2004 | 0.000 | 0.000 | 0.000 | -0.001 | 0.002 | 0.000 | -0.001 | -0.001 | 0.001 | 0.001 | -0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |
| 2005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.001 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.030 | -0.035 | 0.005 | -0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | -0.002 | 0.000 | 0.000 | 0.002 | 0.001 | 0.000 | 0.000 | -0.001 | 0.000 | 0.001 | 0.000 | 0.000 | -0.004 | 0.002 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.005 | -0.011 | 0.002 | 0.004 | 0.015 | -0.010 | 0.002 | -0.004 | -0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | -0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | -0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# Landings

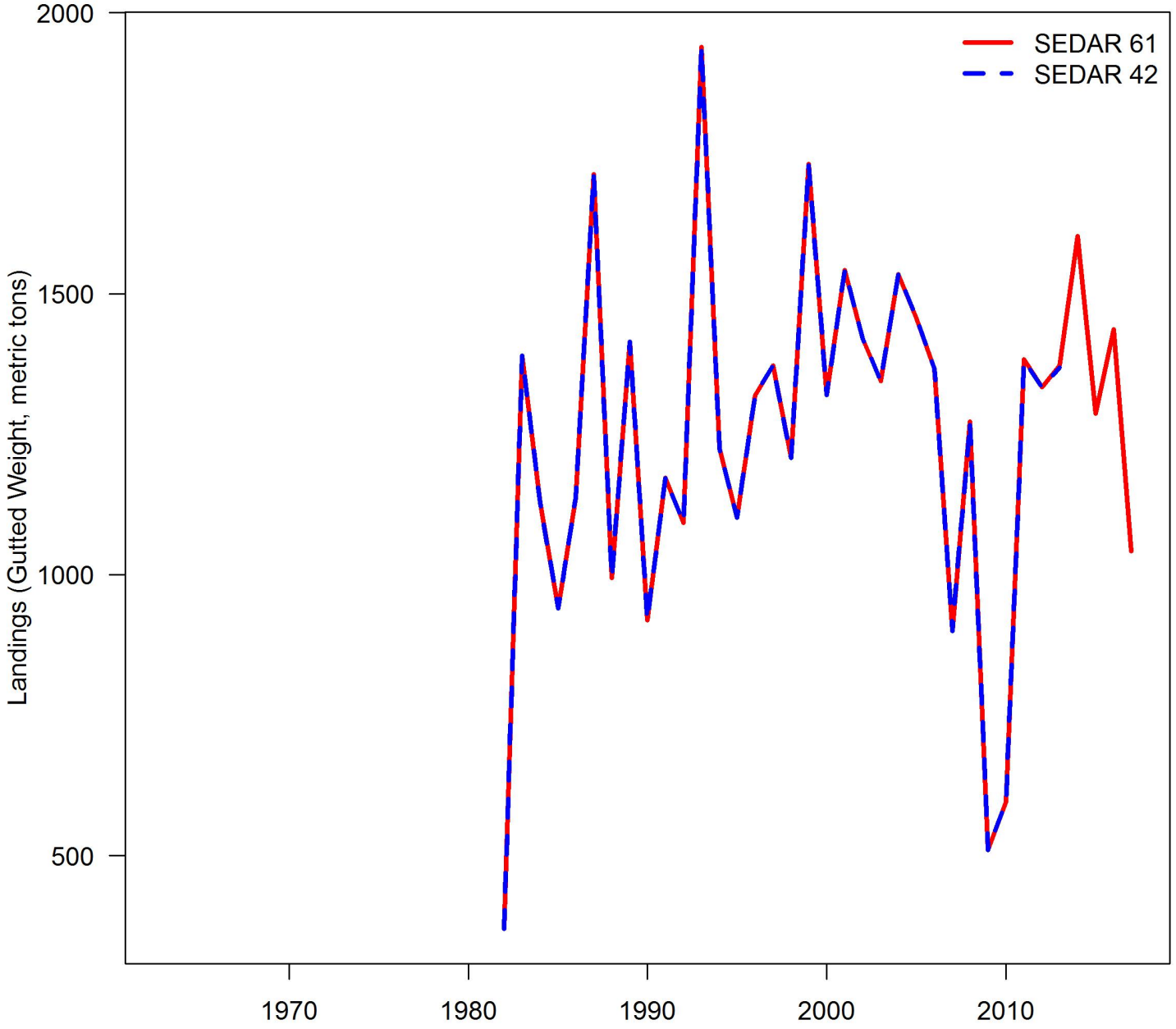
# Commercial Landings

- Data Sources
  - Accumulated landings system (ALS)
  - Florida trip ticket
    - Florida landings
  - Individual Fishing Quota (IFQ) Program
    - Landings in IFQ years

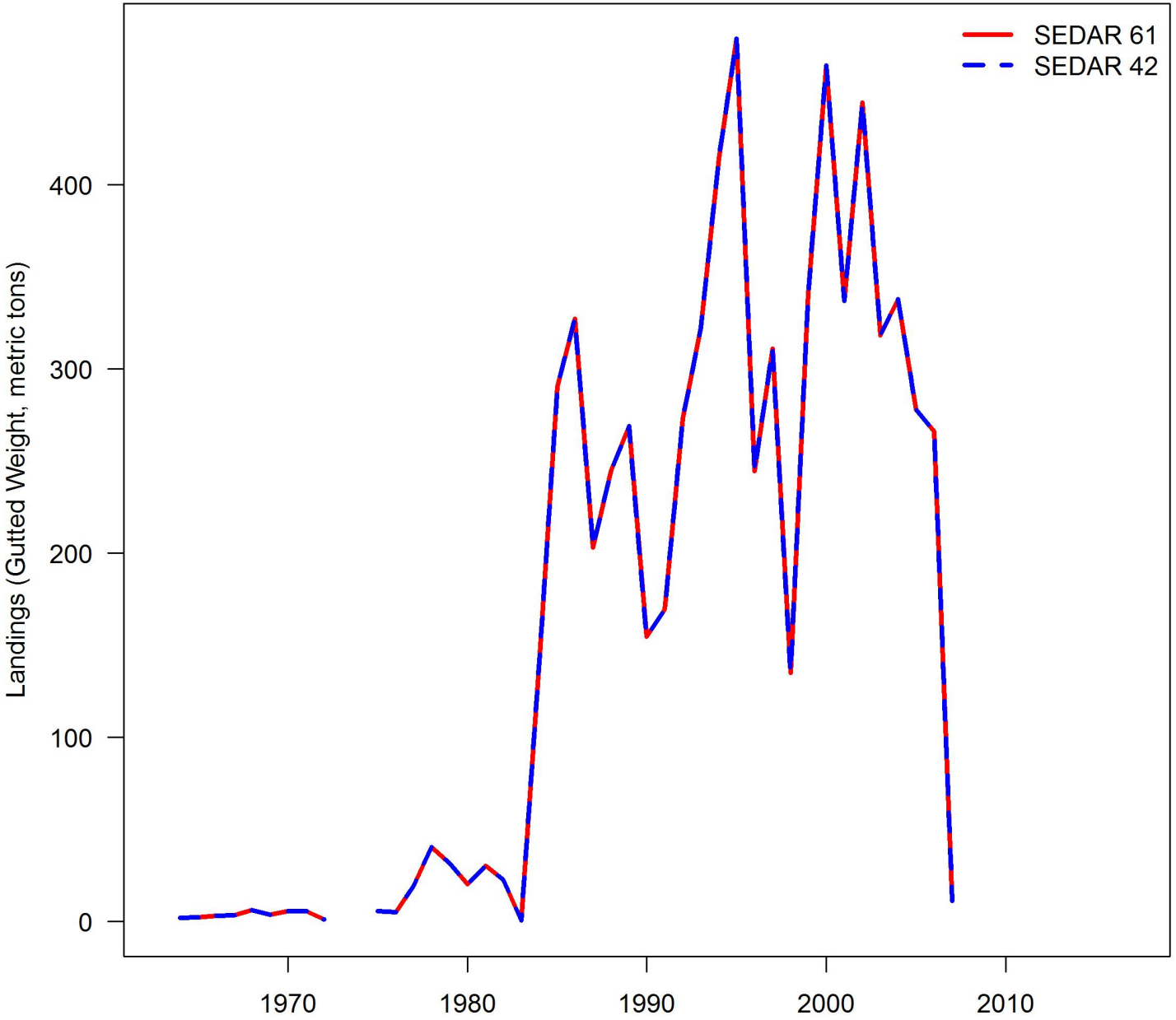
# Commercial Landings – Vertical Line



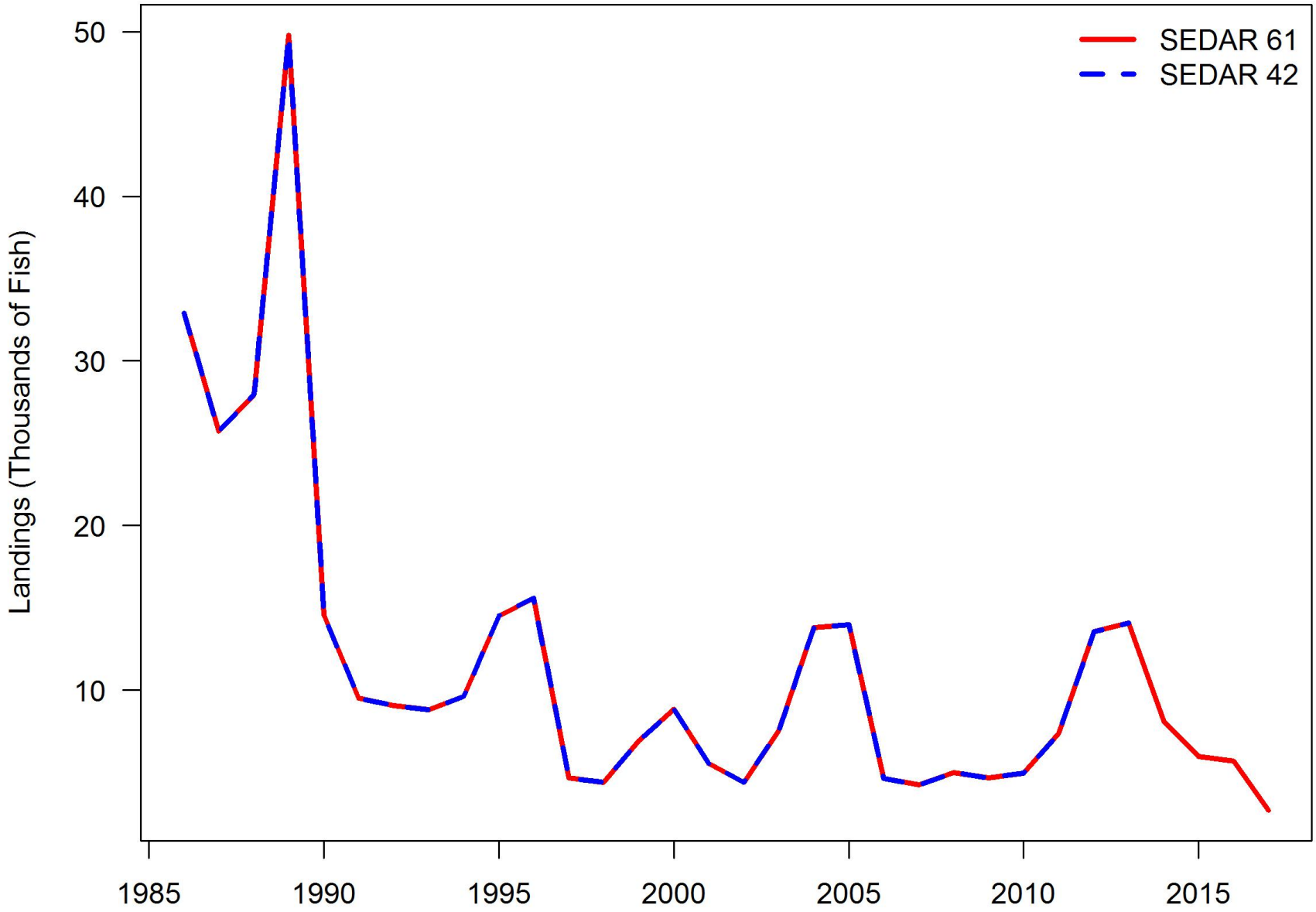
# Commercial Landings - Longline



# Commercial Landings - Trap



# Recreational landings - Headboat



# Discards

# Discard Mortality

## FWC Observer Program 2009-2017

## NMFS Observer Program 2006-2017

| Fleet | Data Source | 42 Discard Rate | Updated* Discard Rate |
|---|---|---|---|
| Commercial HL | FWC Obs. Program (41-50m only) | 19% | 19% |
| Commercial LL Pre-IFQ | NMFS Obs. Program | 41.4% | - |
| Commercial LL Post-IFQ | NMFS Obs. Program | 43.6% | 44.1% |
| Commercial Trap* | SEDAR update 2009* | 10% | - |
| Recreational Fleets | FWC Obs. Program | 11.6% | - |

*Using same methodology as SEDAR 42 and updated RFOP observer data from 2010-2017

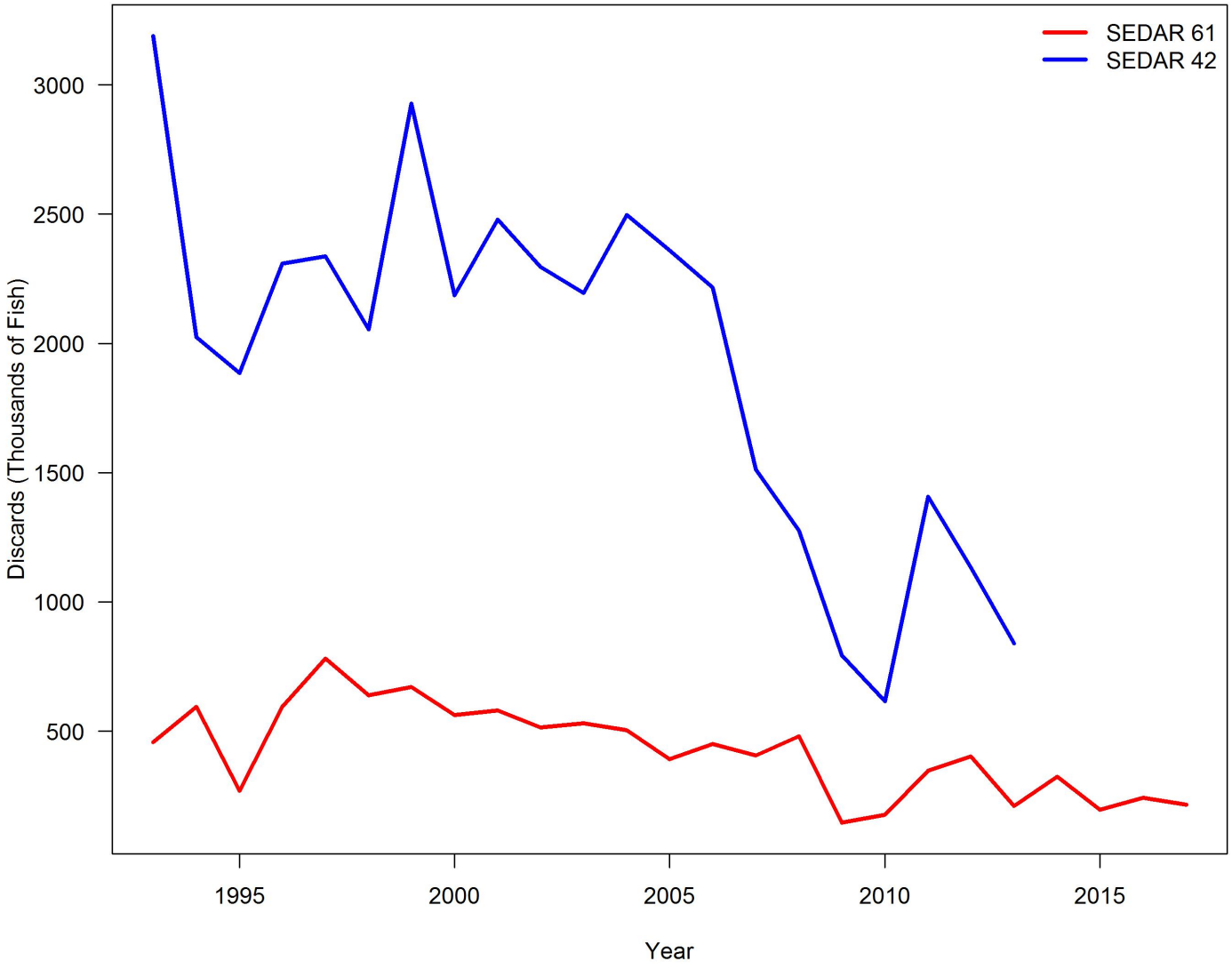
# Commercial discards - continuity

- Work in progress

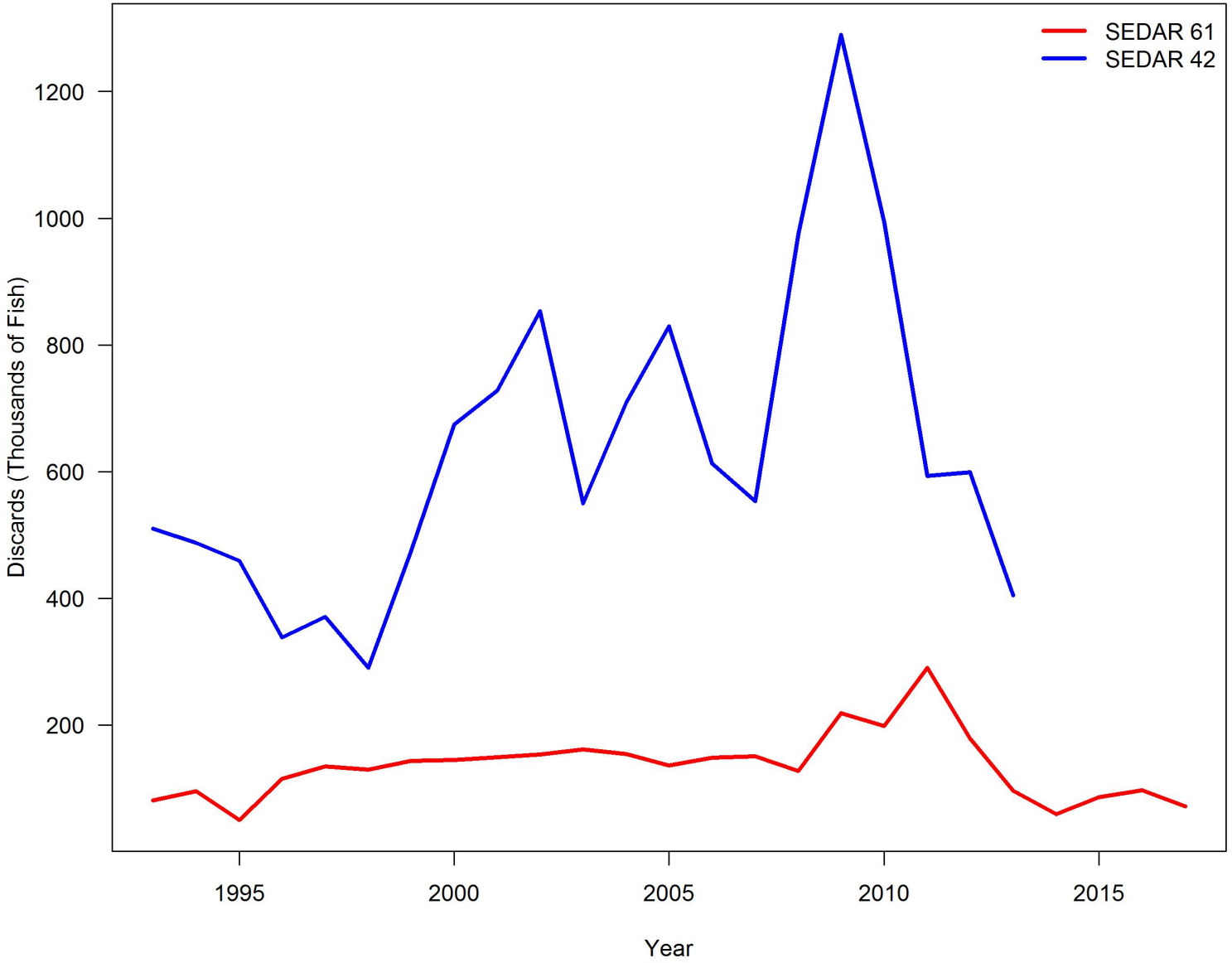
# Commercial discards - updates

- Proposed revisions to methodology

# Updated commercial discards – longline

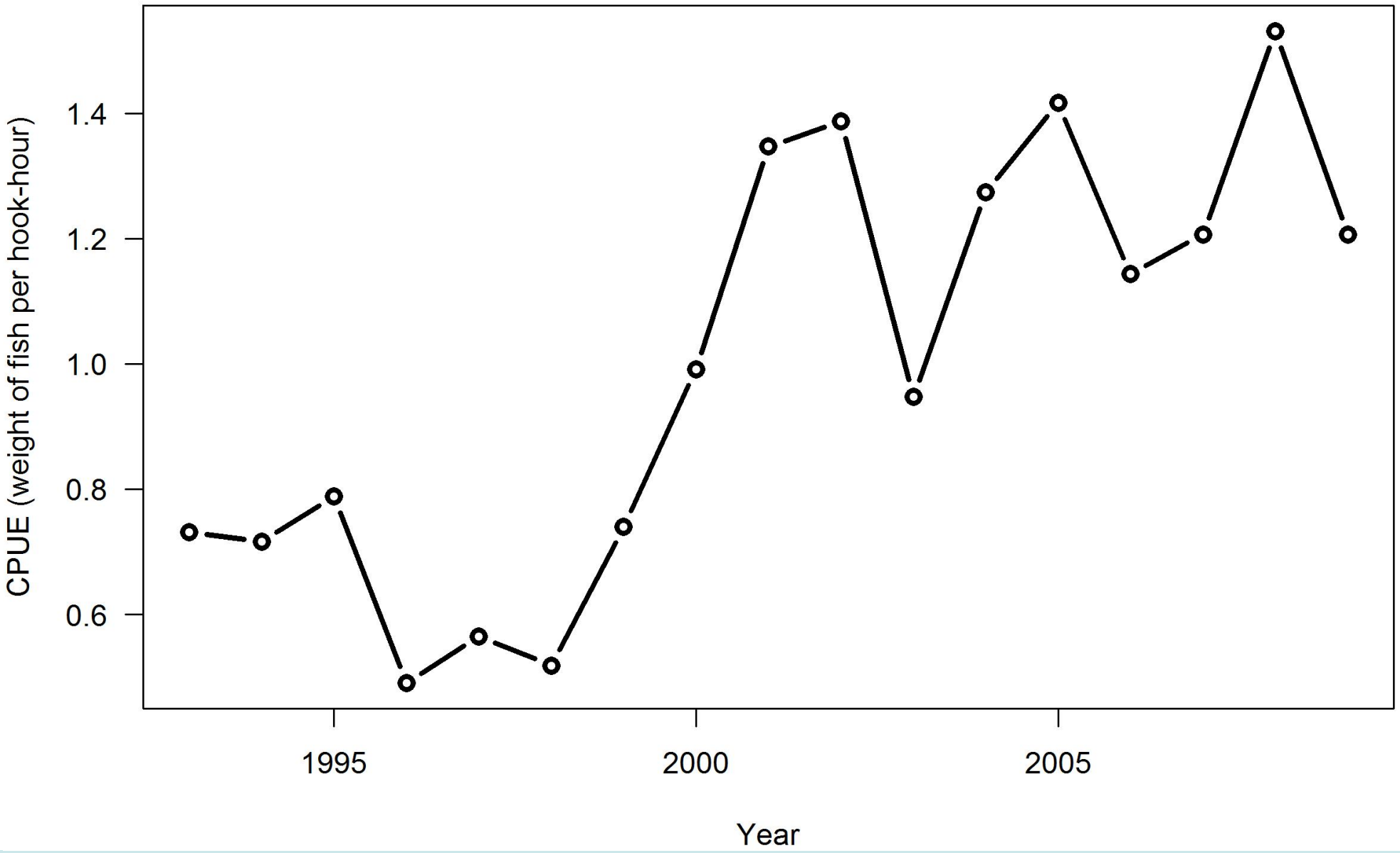


# Updated commercial discards – vertical line

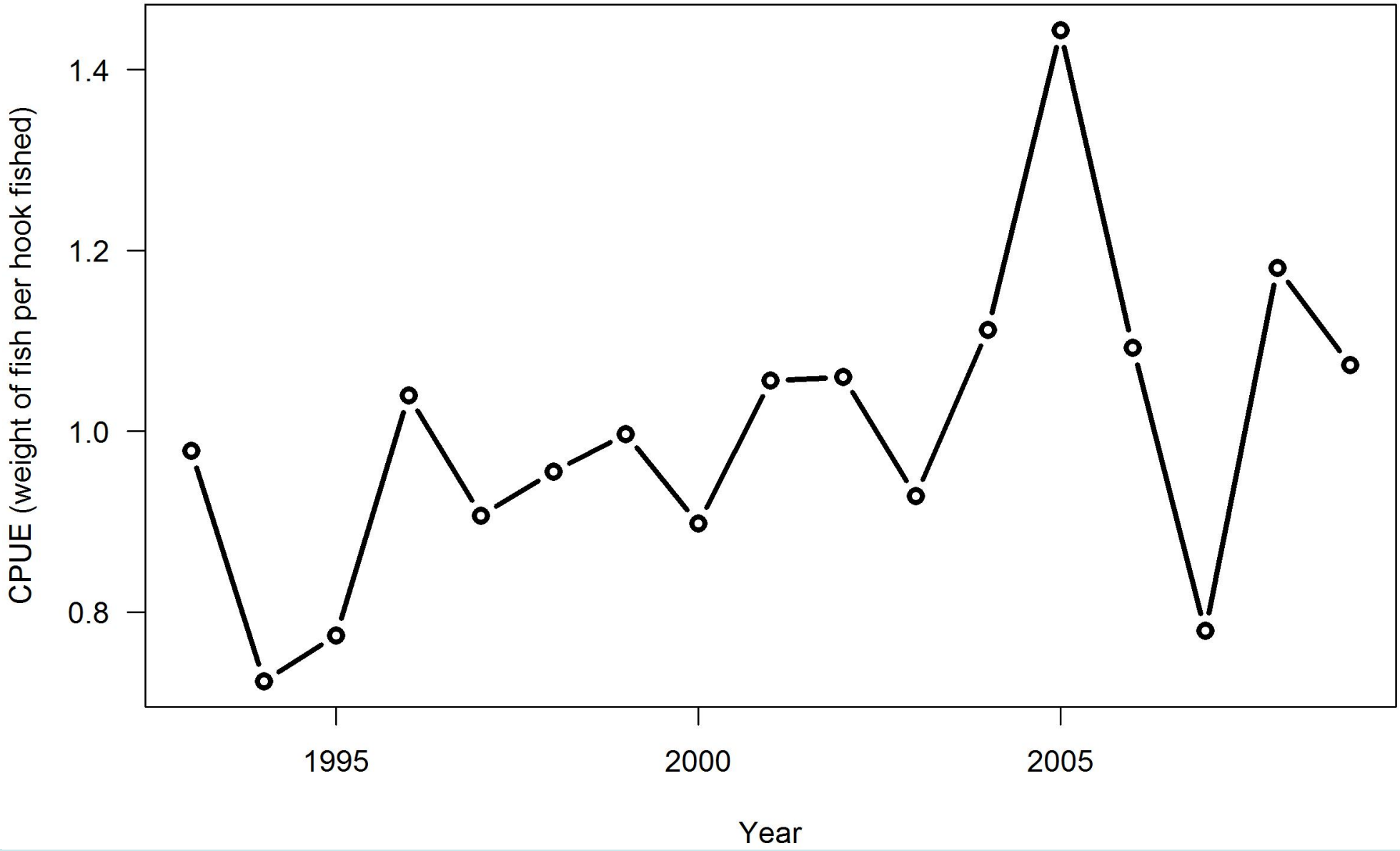


# Indices

# Commercial Handline Index - unchanged



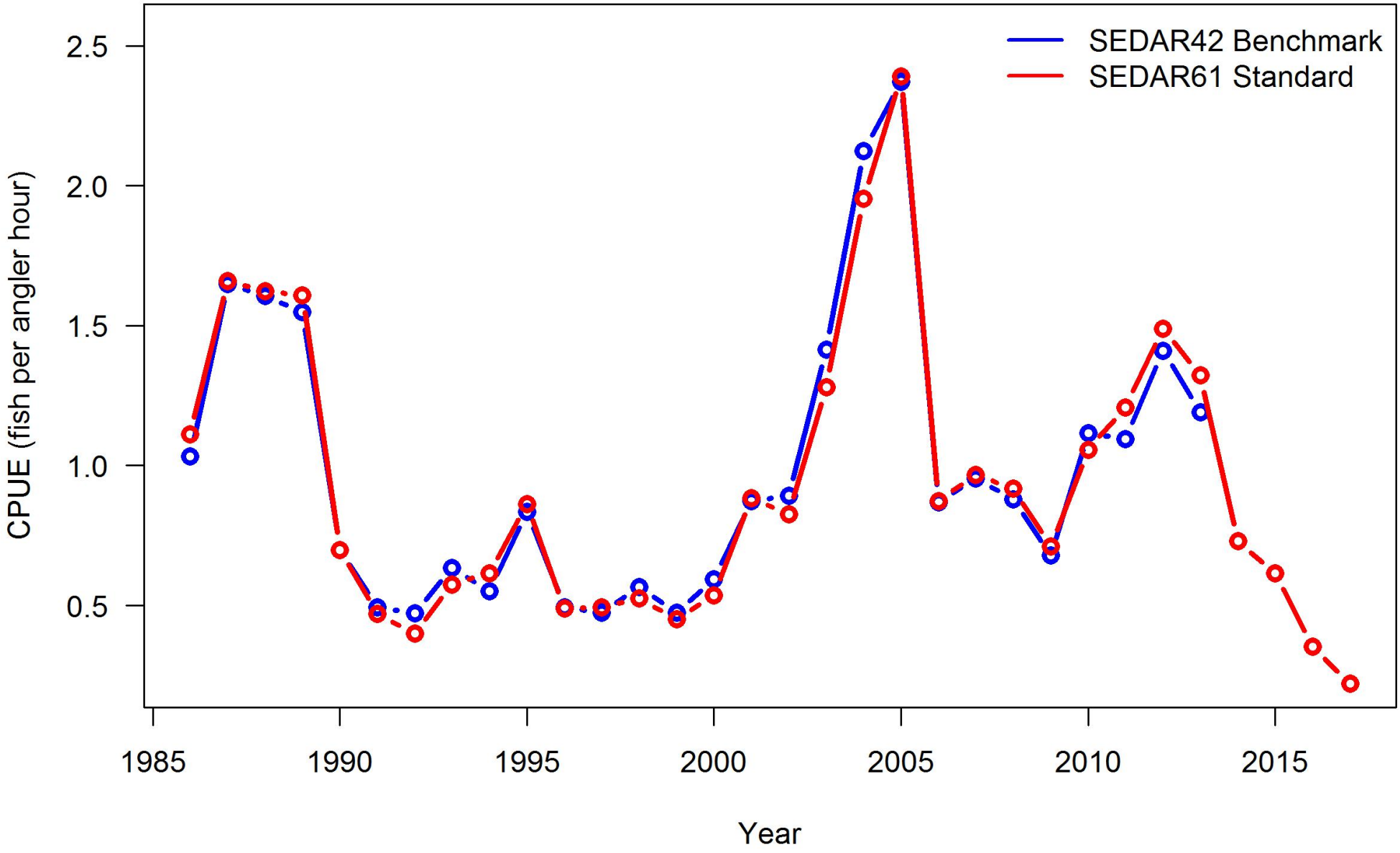
# Commercial Longline Index - unchanged



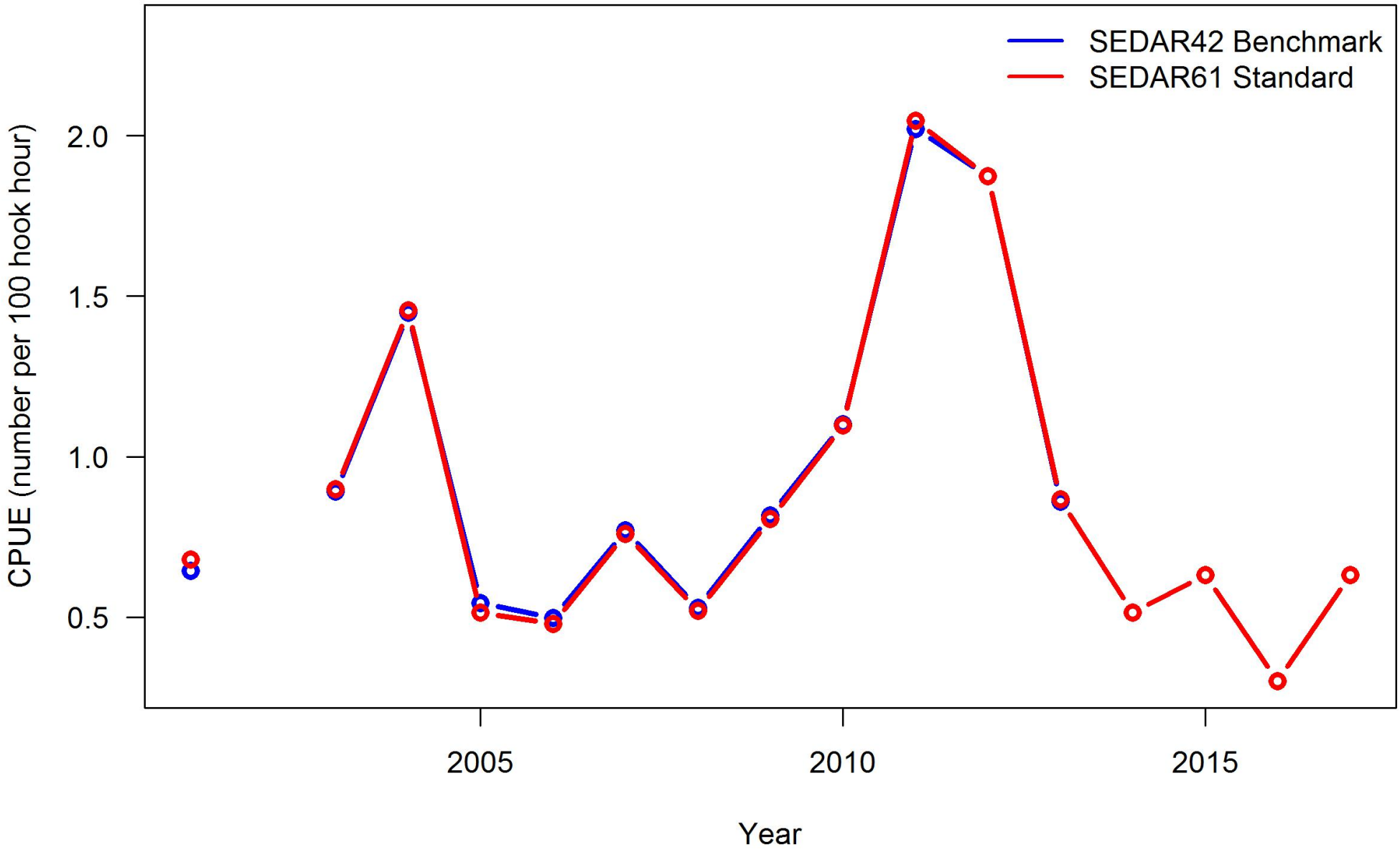
# Commercial Index

- Working on developing a post-IFQ index

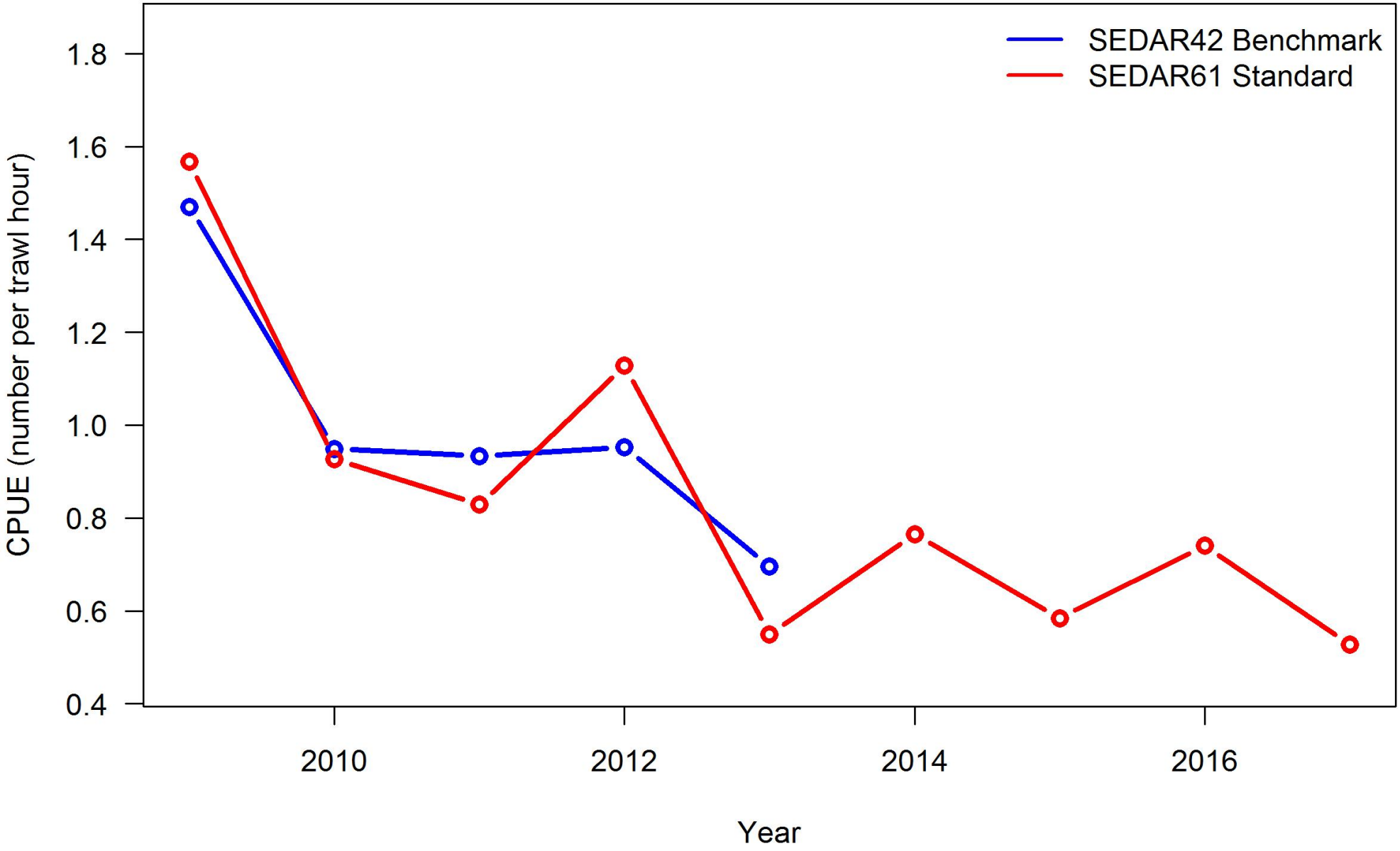
# Headboat Index



# NMFS Bottom Longline Index



# SEAMAP Summer Groundfish Index



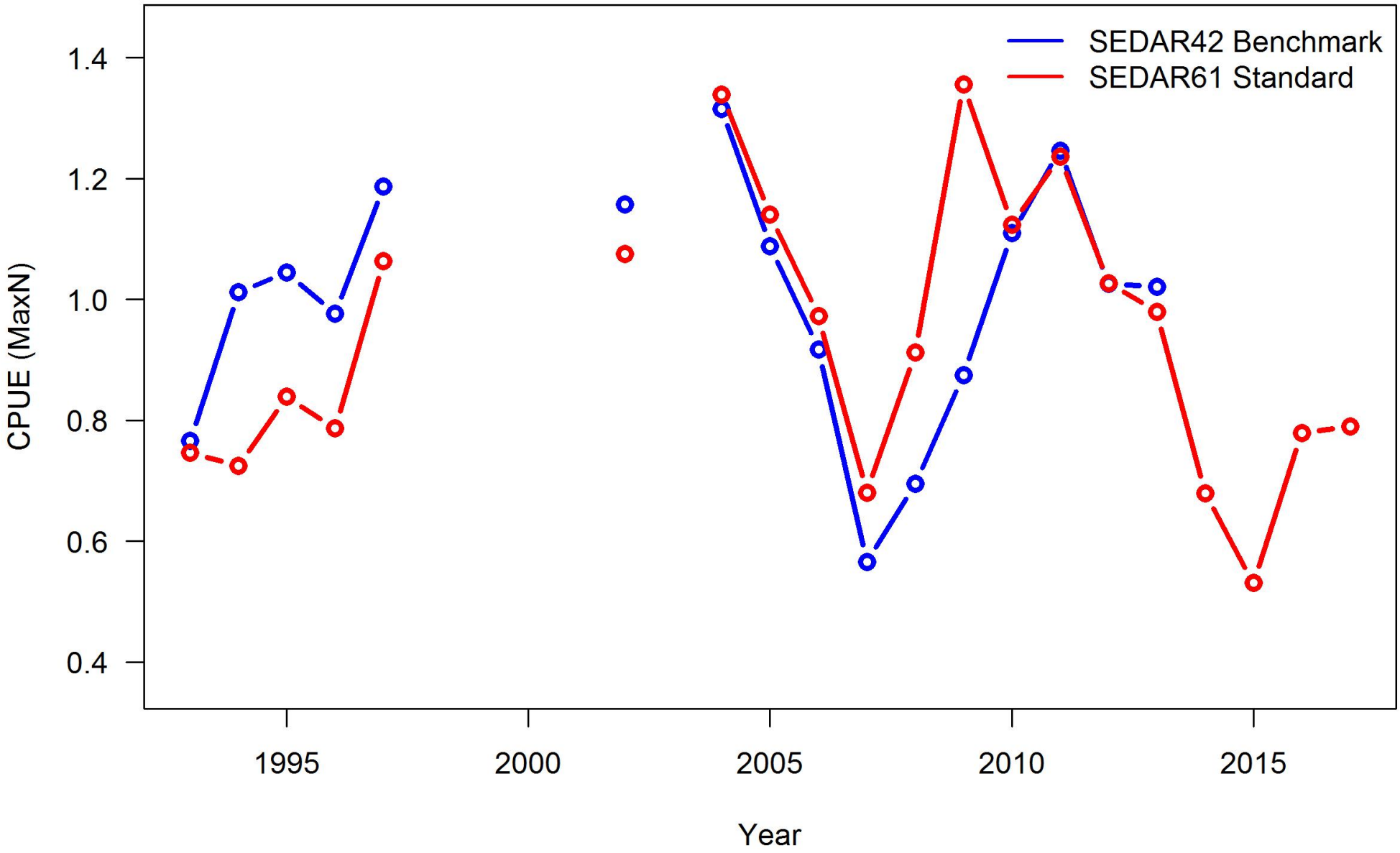
# Combined Video Index – continuity run

- Work in progress

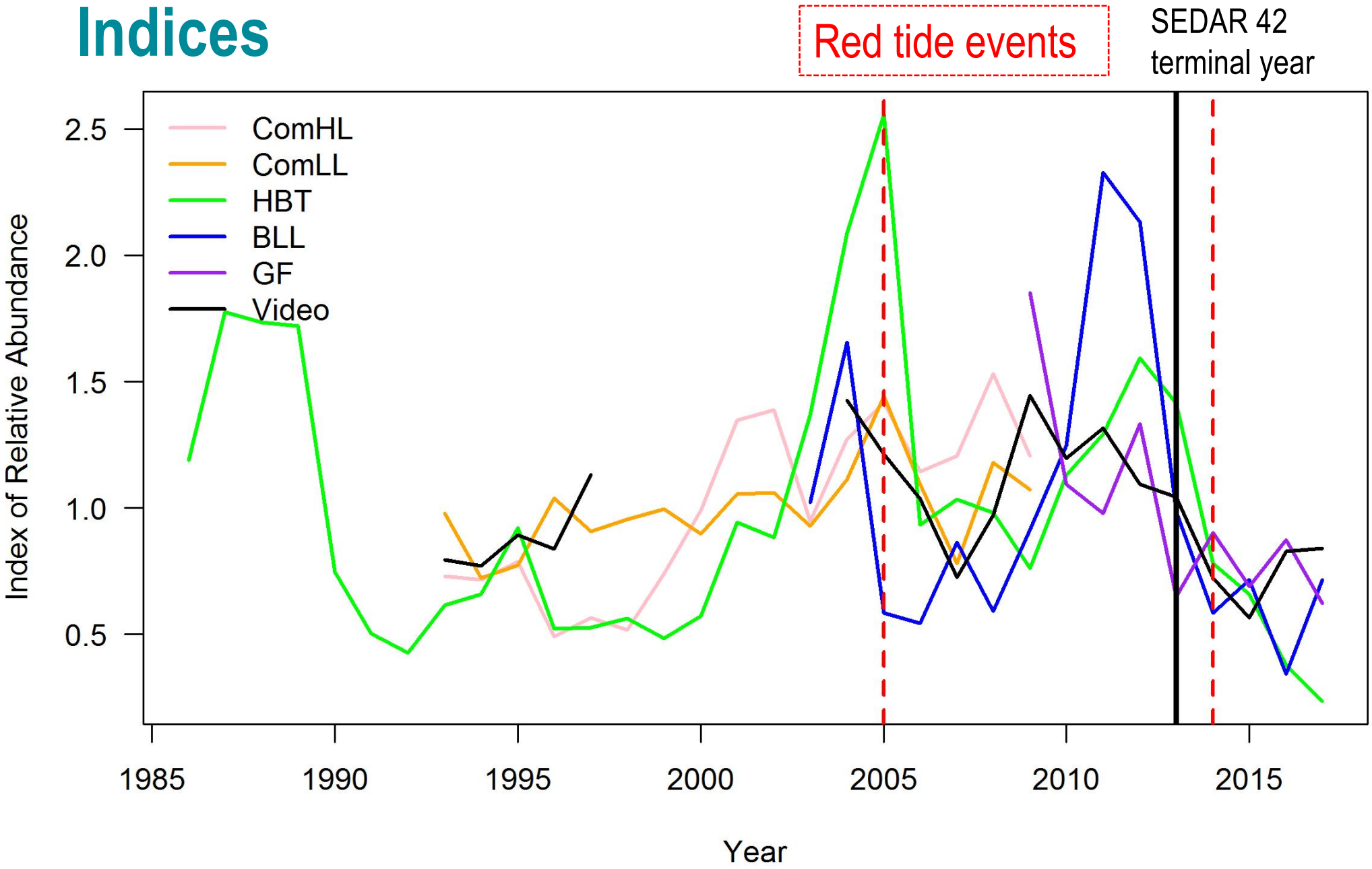
# Comments on Combined Video Survey

- Methodology has evolved since SEDAR42
  - Met in Panama City Feb 12-14 to refine new weighting technique based on habitat
  - Proposed revisions to methodology

# Combined Video Index – revised methodology



# Indices


Red tide events
SEDAR 42
terminal year
ComHL
ComLL
HBT
BLL
GF
Video
Index of Relative Abundance
2.5
2.0
1.5
1.0
0.5
1985
1990
1995
2000
2005
2010
2015
Year

# Length composition

# Commercial Discards Length Composition

- NMFS Observer Program
  - Commercial vertical line (2006 – 2017)
  - Commercial longline (2006 – 2017)

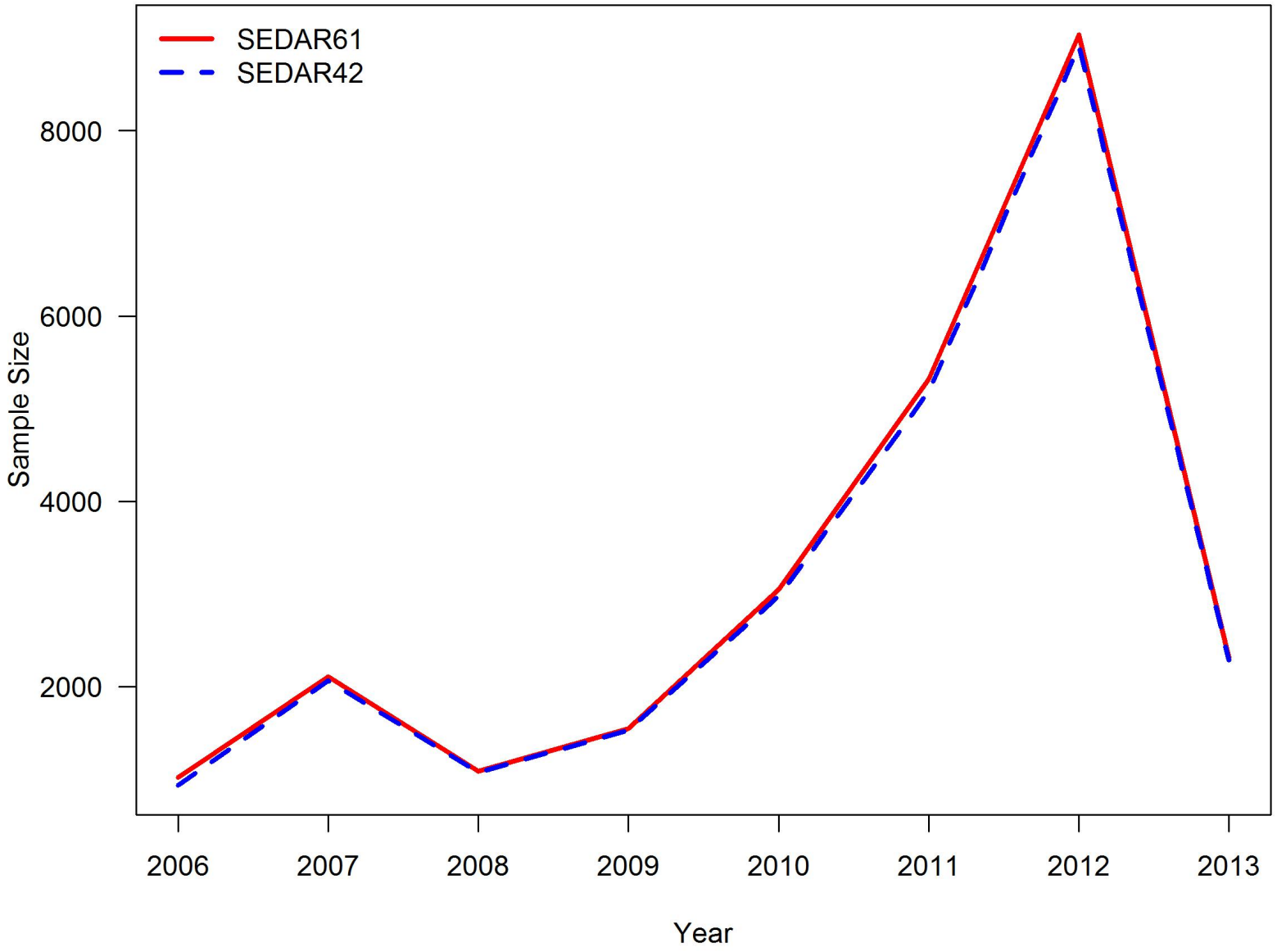
# Commercial Discards – Vertical Line

| Year | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.002 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | -0.001 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Year | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | -0.002 | 0.004 | 0.000 | -0.002 | 0.004 | 0.002 | 0.001 | -0.006 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | 0.000 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | 0.001 | 0.001 | -0.001 | 0.000 | -0.003 | 0.001 | 0.002 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | -0.001 | -0.001 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | -0.001 | -0.001 | -0.003 | 0.002 | 0.002 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | -0.001 | 0.000 | -0.002 | 0.004 | -0.002 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | -0.001 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | -0.001 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Year | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# Commercial Discards – Vertical Line (sample sizes)



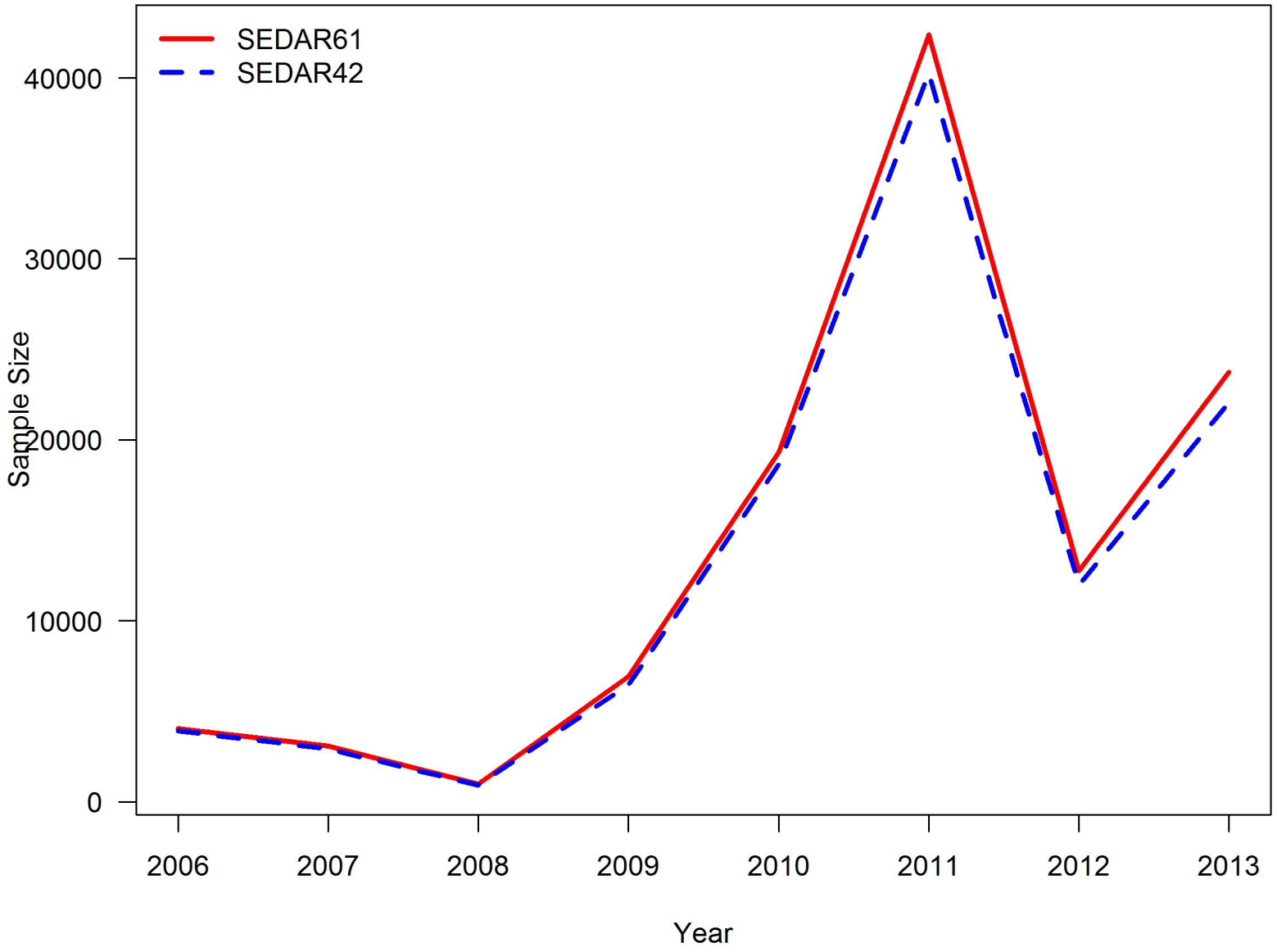
# Commercial Discards – Longline

| Year | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.001 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.003 | -0.002 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.003 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 |

| Year | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | -0.003 | -0.003 | 0.002 | 0.006 | 0.008 | 0.005 | 0.001 | -0.001 | -0.002 | -0.003 | -0.002 | -0.002 | -0.001 | -0.001 | -0.001 | 0.000 |
| 2007 | -0.001 | 0.000 | 0.000 | -0.001 | 0.002 | 0.003 | 0.003 | -0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | -0.003 | -0.002 | 0.002 | 0.005 | 0.003 | 0.003 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | -0.003 | 0.000 | -0.004 | -0.002 | -0.001 | 0.010 | 0.007 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.001 | 0.001 | 0.001 | 0.000 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | -0.001 | 0.000 | 0.000 | 0.002 | 0.002 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | -0.001 | -0.002 | 0.002 | 0.002 | 0.004 | -0.001 | 0.000 | -0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | -0.002 | -0.001 | -0.002 | -0.001 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Year | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# Commercial Discards – Longline (sample sizes)



# Recreational Discards Length Composition

- FWRI At-sea Observer Survey:
  - Headboat since 2005
  - Charterboat since June 2009
- Cooperative vessels randomly selected year-round for observer coverage
- Samples stratified by region
- Weighting factors based on different trip-types for Headboat

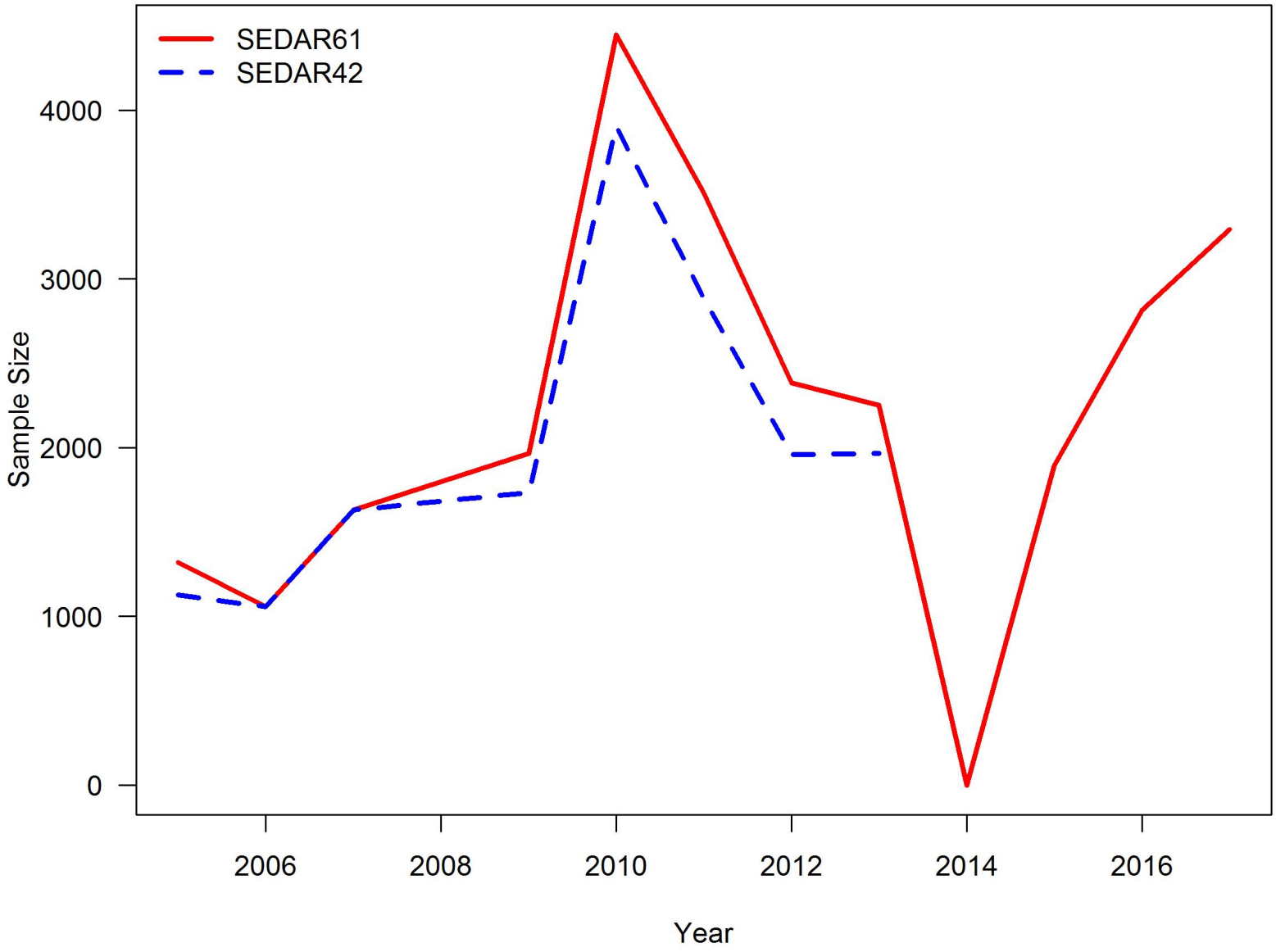
# Recreational Discards – Combined

| Year | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.006 | -0.005 | 0.003 | -0.005 | -0.005 | -0.003 | -0.006 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.001 | -0.001 | -0.002 | -0.009 | -0.012 | 0.001 | -0.003 | -0.011 | -0.012 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.003 | -0.004 | -0.012 | -0.011 | -0.016 | -0.021 | -0.016 | -0.006 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.003 | -0.005 | -0.006 | -0.008 | -0.016 | -0.024 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.002 | -0.005 | -0.015 | -0.045 | -0.099 | -0.111 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | -0.001 | -0.001 | -0.007 | -0.011 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | -0.001 | -0.003 | -0.001 | 0.002 | 0.024 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.001 | -0.001 | -0.007 | -0.012 | -0.035 |

| Year | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | -0.012 | -0.019 | -0.016 | -0.016 | -0.017 | -0.021 | -0.013 | -0.004 | -0.003 | -0.002 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2006 | -0.012 | -0.014 | -0.011 | -0.019 | -0.011 | -0.014 | -0.011 | -0.004 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | -0.008 | -0.010 | -0.006 | -0.005 | -0.008 | -0.007 | -0.007 | -0.007 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | -0.026 | -0.023 | -0.016 | -0.010 | -0.006 | -0.003 | -0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | -0.110 | -0.115 | -0.046 | 0.055 | 0.127 | 0.163 | 0.109 | 0.074 | 0.018 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | -0.037 | -0.078 | -0.091 | -0.059 | 0.020 | 0.067 | 0.129 | 0.072 | 0.002 | 0.001 | -0.001 | -0.002 | -0.001 | -0.001 | 0.000 | 0.000 |
| 2012 | 0.085 | 0.086 | 0.049 | 0.002 | -0.038 | -0.087 | -0.081 | -0.028 | -0.002 | -0.002 | 0.001 | -0.003 | -0.001 | -0.001 | 0.000 | -0.001 |
| 2013 | -0.004 | 0.056 | 0.099 | 0.129 | 0.048 | -0.087 | -0.126 | -0.051 | -0.001 | -0.001 | -0.001 | -0.002 | -0.001 | 0.000 | 0.000 | -0.001 |

| Year | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | -0.001 | 0.000 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# Recreational Discards – sample size



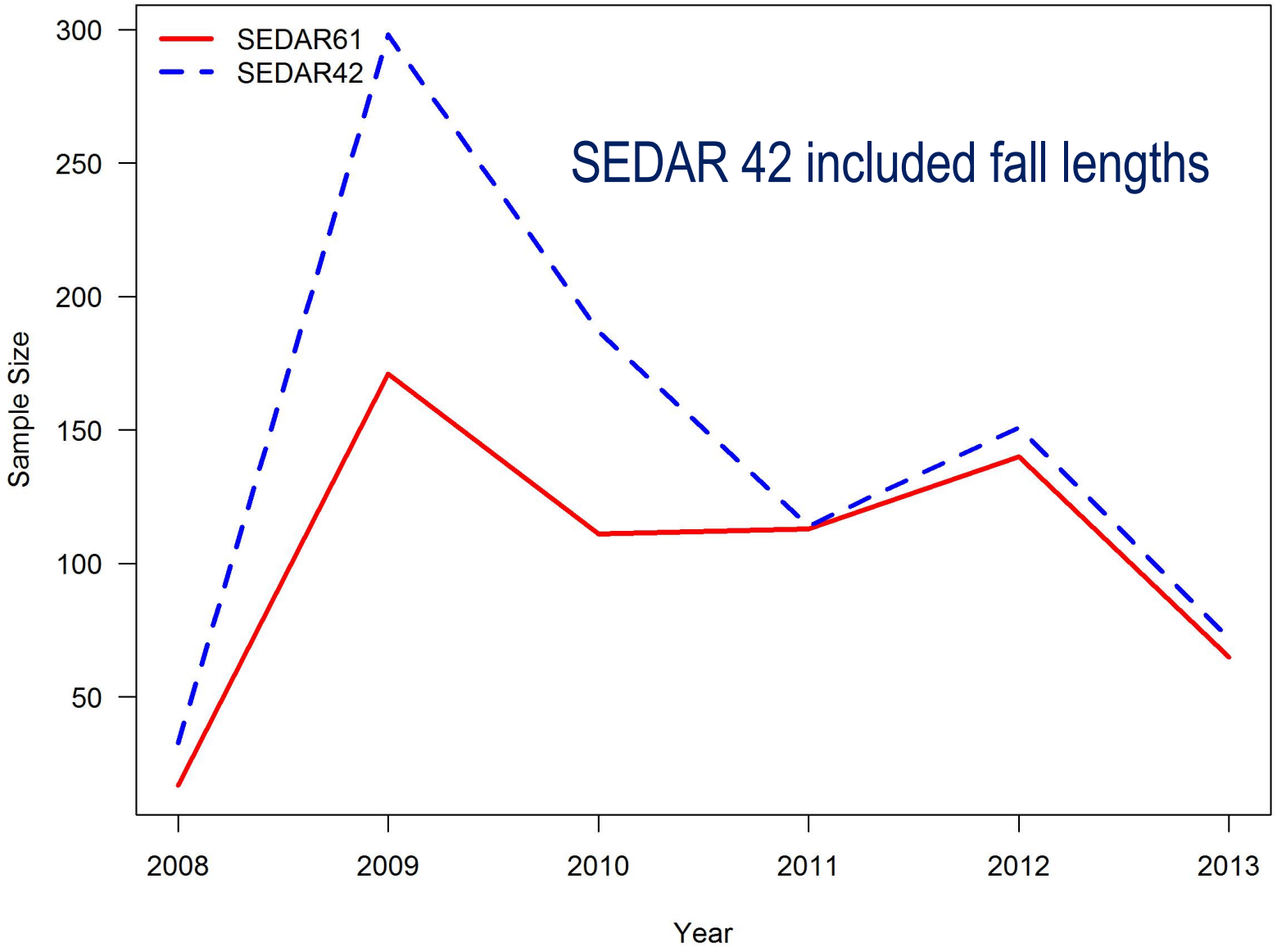
# NMFS Groundfish (Summer)

| Year | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0.000 | 0.000 | -0.030 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.029 | 0.057 | -0.032 | -0.032 | 0.171 | 0.025 | -0.062 | -0.002 |
| 2009 | 0.000 | 0.000 | 0.005 | -0.001 | -0.010 | -0.017 | 0.002 | 0.005 | 0.010 | 0.015 | 0.051 | 0.090 | 0.038 | -0.014 | -0.049 | -0.044 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.002 | 0.024 | 0.042 | 0.006 | 0.011 | 0.009 | 0.026 | 0.050 | 0.032 | -0.001 | 0.006 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.001 | 0.001 | -0.008 | 0.001 | 0.000 | 0.001 |
| 2012 | 0.001 | 0.004 | 0.001 | 0.002 | -0.006 | 0.000 | 0.001 | 0.004 | -0.010 | 0.002 | 0.002 | 0.005 | 0.000 | 0.005 | -0.002 | -0.002 |
| 2013 | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.004 | 0.001 | 0.001 | -0.009 | 0.007 | 0.003 | 0.004 | 0.004 | -0.037 | 0.001 | 0.009 |

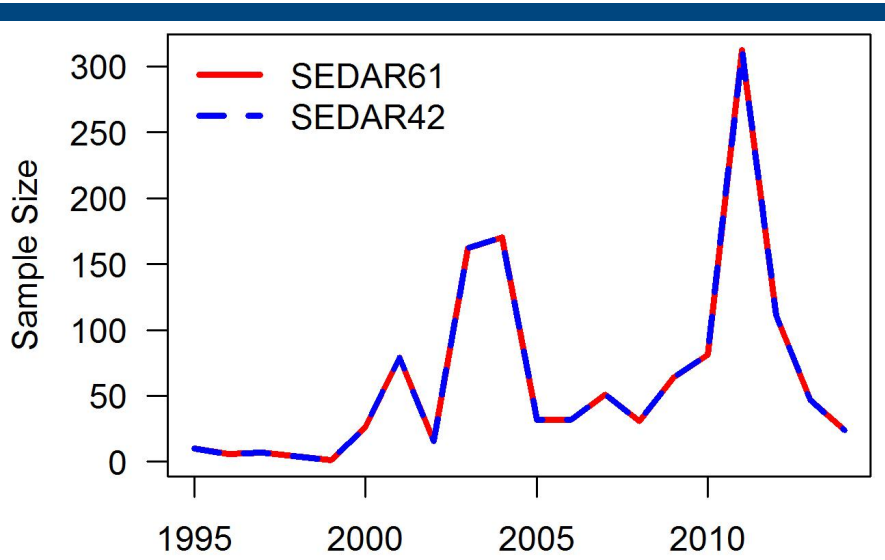
| Year | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | -0.061 | 0.000 | 0.000 | -0.061 | 0.000 | 0.000 | 0.029 | 0.000 | 0.000 | 0.000 | 0.000 | -0.030 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | -0.015 | -0.026 | -0.014 | -0.011 | -0.012 | 0.007 | -0.003 | -0.001 | 0.000 | 0.002 | -0.003 | 0.005 | 0.000 | 0.000 | -0.003 | 0.000 |
| 2010 | -0.041 | -0.016 | -0.062 | -0.041 | -0.014 | -0.012 | -0.011 | -0.002 | -0.005 | 0.004 | 0.000 | 0.000 | 0.000 | -0.005 | -0.005 | 0.000 |
| 2011 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.003 | -0.015 | 0.002 | -0.005 | 0.004 | 0.003 | 0.002 | -0.003 | 0.001 | 0.003 | 0.001 | 0.001 | 0.000 | 0.000 | 0.001 | 0.000 |
| 2013 | 0.004 | 0.003 | 0.004 | 0.006 | 0.007 | 0.007 | -0.012 | 0.000 | -0.011 | 0.001 | 0.003 | 0.000 | 0.000 | -0.012 | 0.000 | 0.001 |

| Year | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | -0.003 | -0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# NMFS Groundfish (Summer) – sample sizes

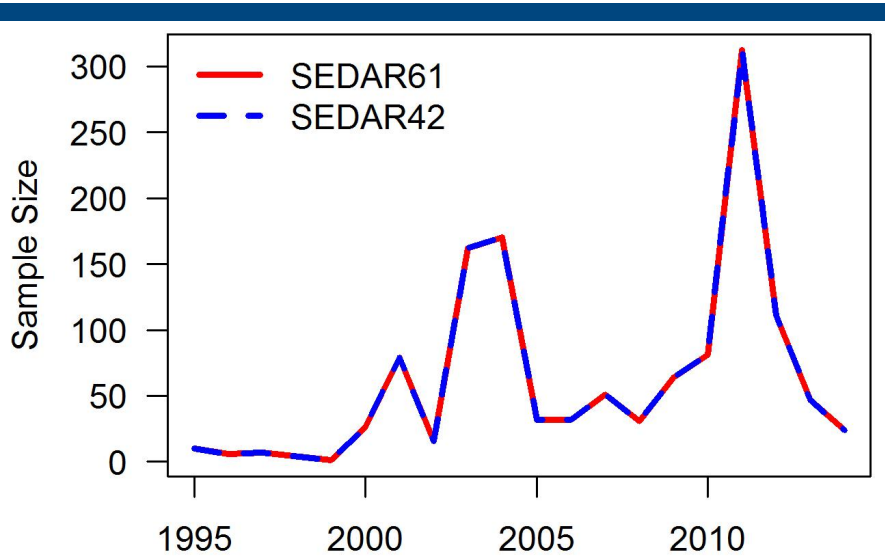


# NMFS Bottom Longline




| Year | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1996 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1997 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1999 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

# NMFS Bottom Longline




| Year | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1996 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1997 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1999 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.016 | 0.000 | 0.016 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2014 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

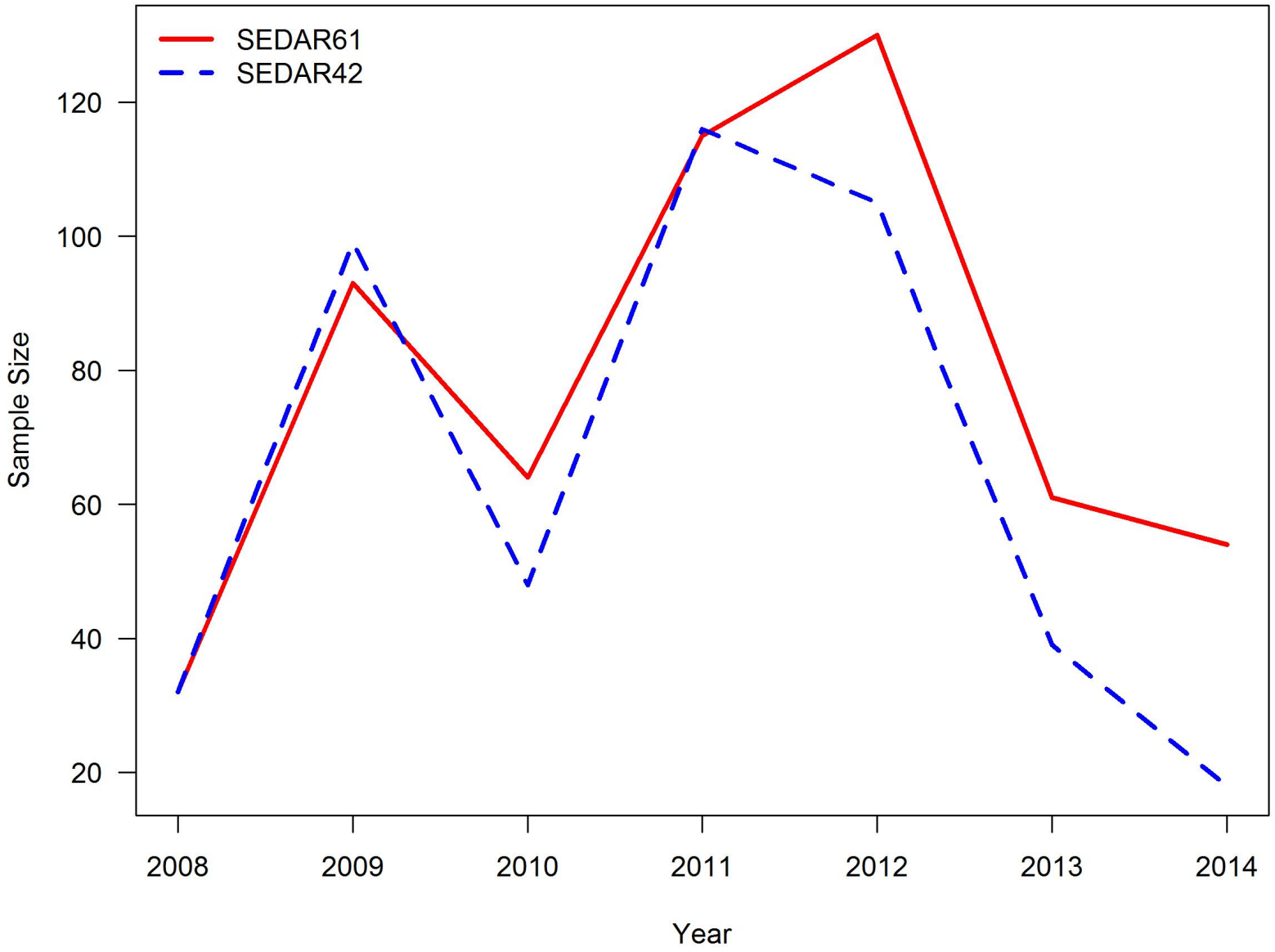
# Video Survey (PC & SEAMAP combined last time)

| Year | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | -0.007 | -0.017 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.005 | 0.000 | -0.010 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.002 | -0.002 | -0.002 | 0.000 | -0.007 |
| 2013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.009 | 0.000 | -0.009 |

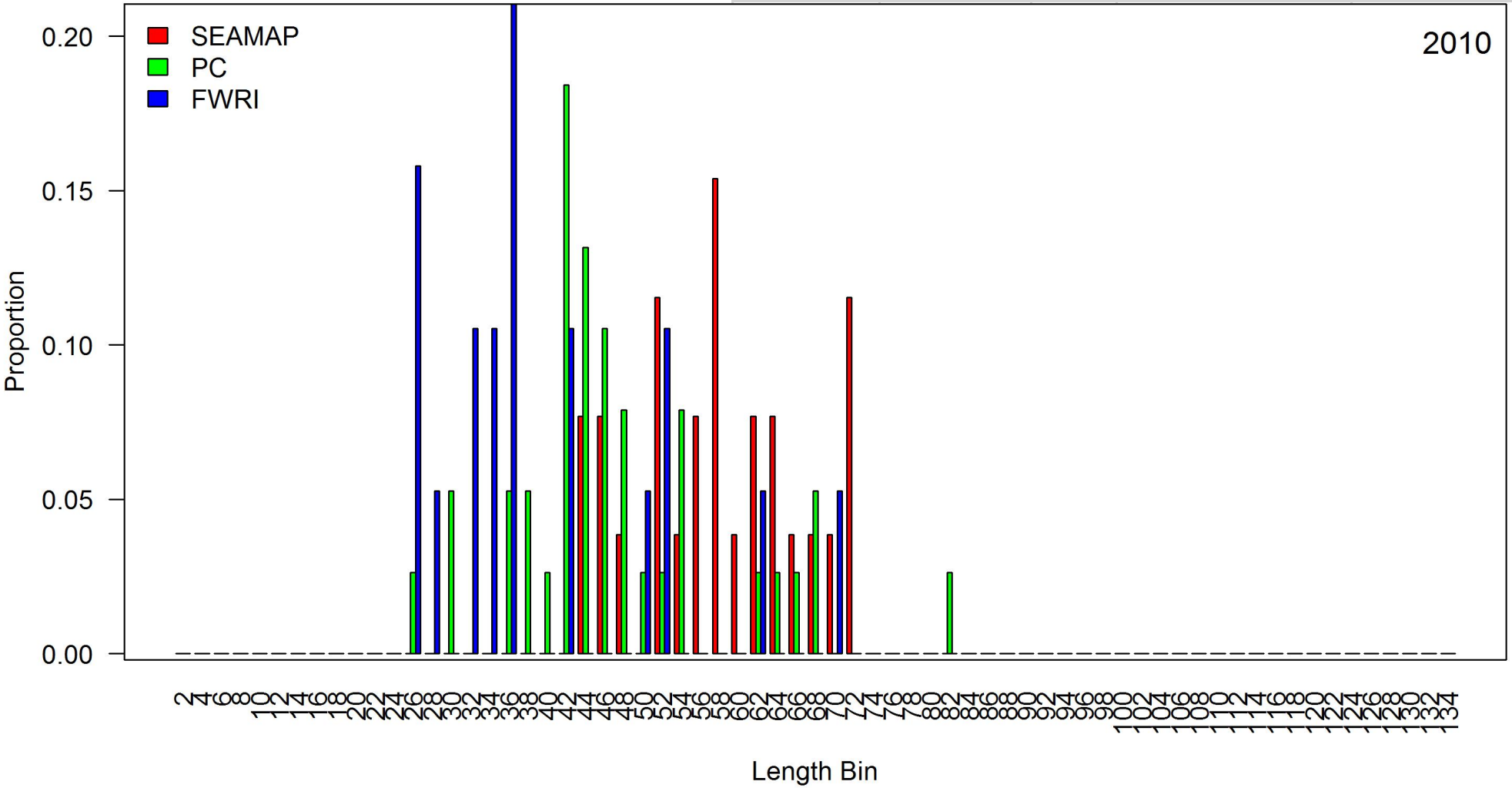
| Year | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.006 | 0.003 | -0.012 | -0.029 | 0.005 | 0.004 | 0.004 | 0.002 | 0.003 | 0.013 | 0.004 | 0.001 | 0.013 | 0.001 | 0.000 | 0.001 |
| 2010 | 0.000 | -0.010 | -0.010 | -0.005 | -0.036 | -0.036 | -0.010 | 0.000 | -0.026 | 0.021 | -0.021 | 0.010 | 0.000 | 0.016 | 0.026 | 0.026 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 |
| 2012 | -0.009 | -0.002 | -0.013 | 0.004 | -0.001 | 0.010 | 0.001 | 0.001 | 0.001 | -0.003 | -0.001 | -0.011 | -0.007 | -0.002 | 0.006 | 0.012 |
| 2013 | 0.000 | -0.028 | -0.018 | -0.018 | -0.009 | -0.018 | -0.030 | -0.028 | 0.082 | 0.014 | 0.014 | 0.014 | 0.005 | 0.024 | 0.033 | 0.007 |

| Year | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2009 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2010 | 0.010 | 0.005 | 0.016 | 0.047 | 0.000 | 0.000 | 0.000 | 0.000 | -0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | -0.002 | 0.004 | 0.012 | 0.000 | -0.005 | -0.004 | 0.015 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.008 | 0.000 | 0.000 |
| 2013 | 0.000 | -0.028 | 0.024 | 0.016 | -0.009 | 0.000 | -0.009 | -0.009 | -0.009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

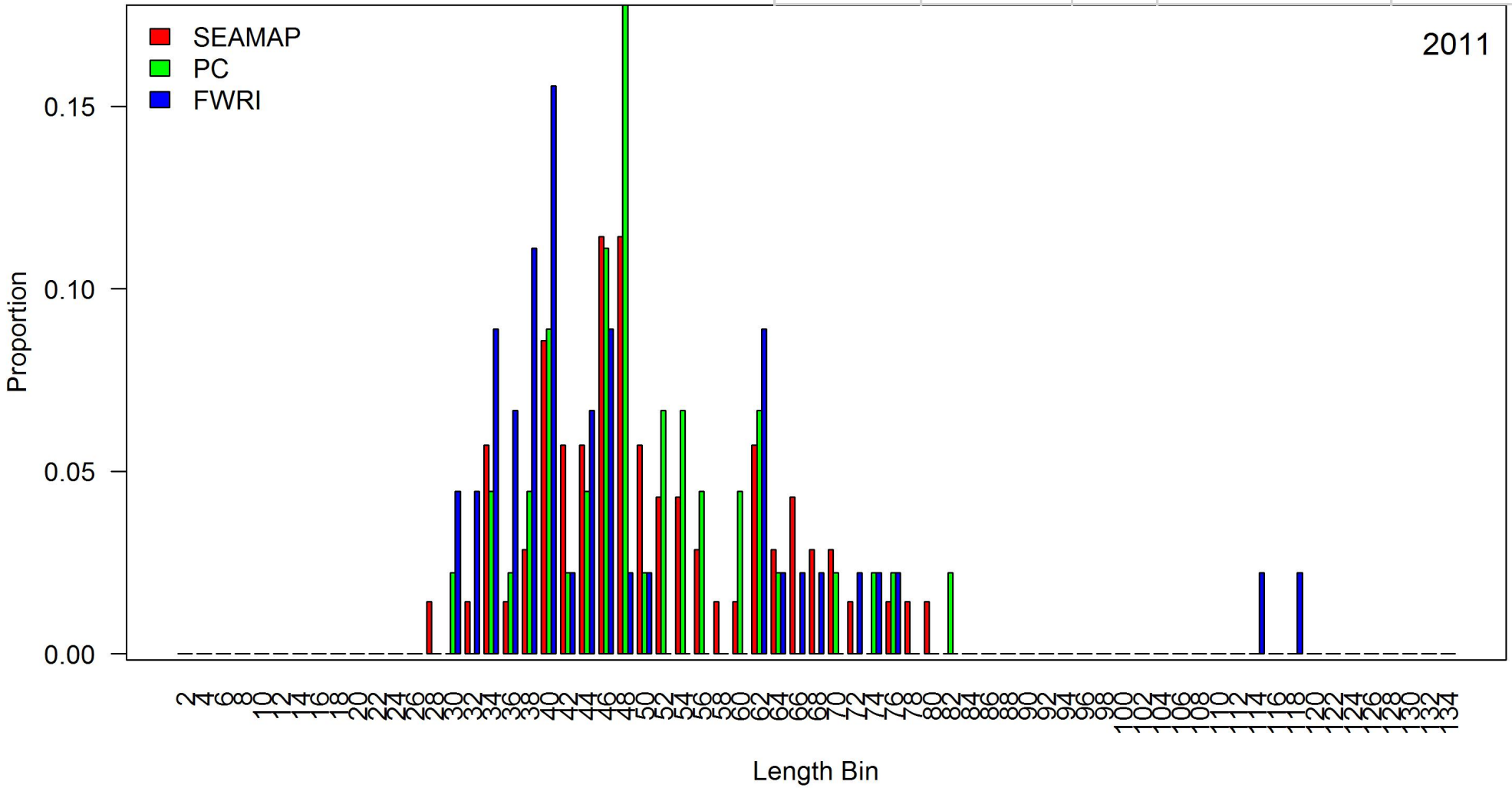
# Video Survey – sample sizes



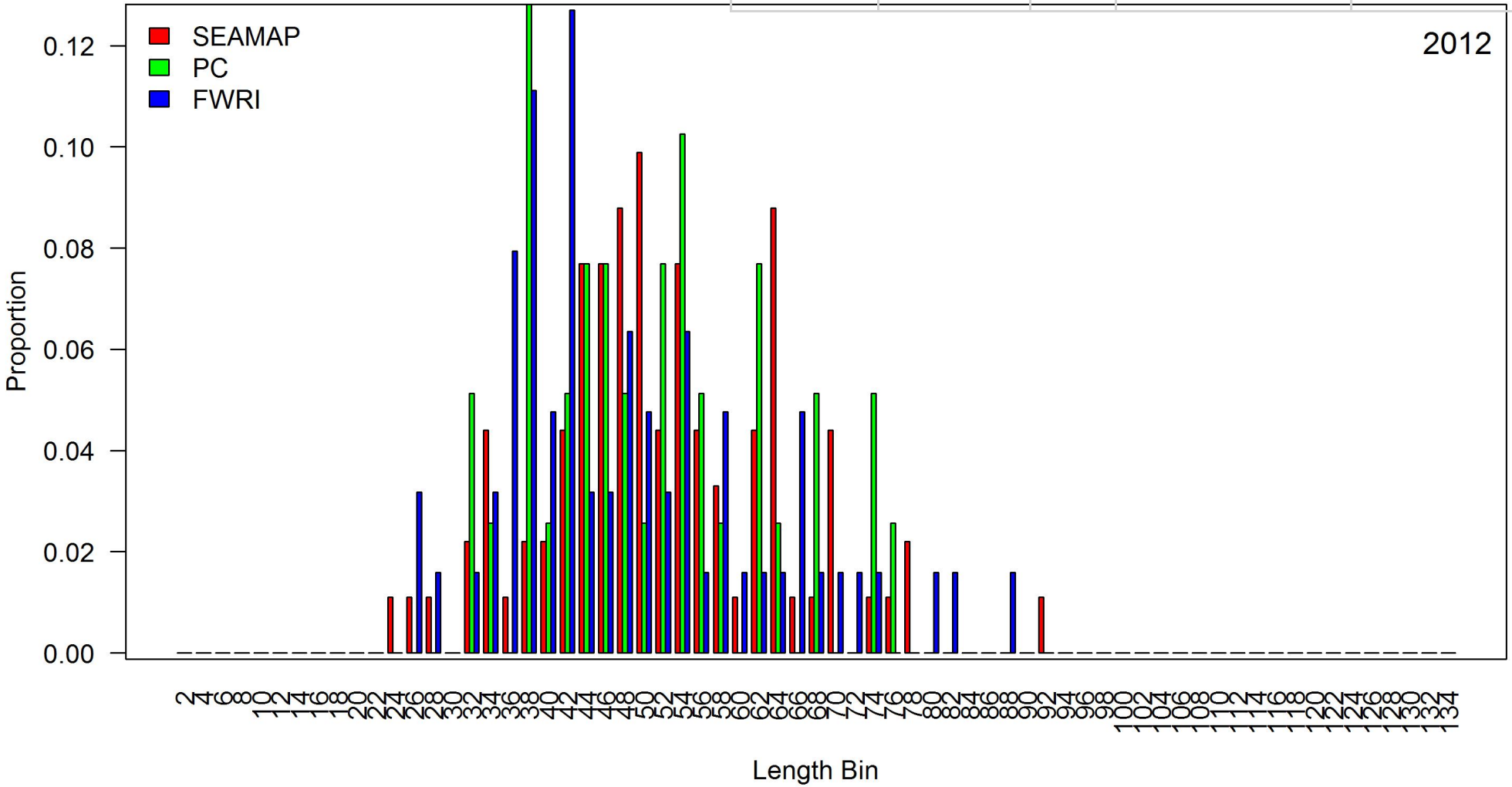
| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2010 | 19 | 38 | 26 | 83 |



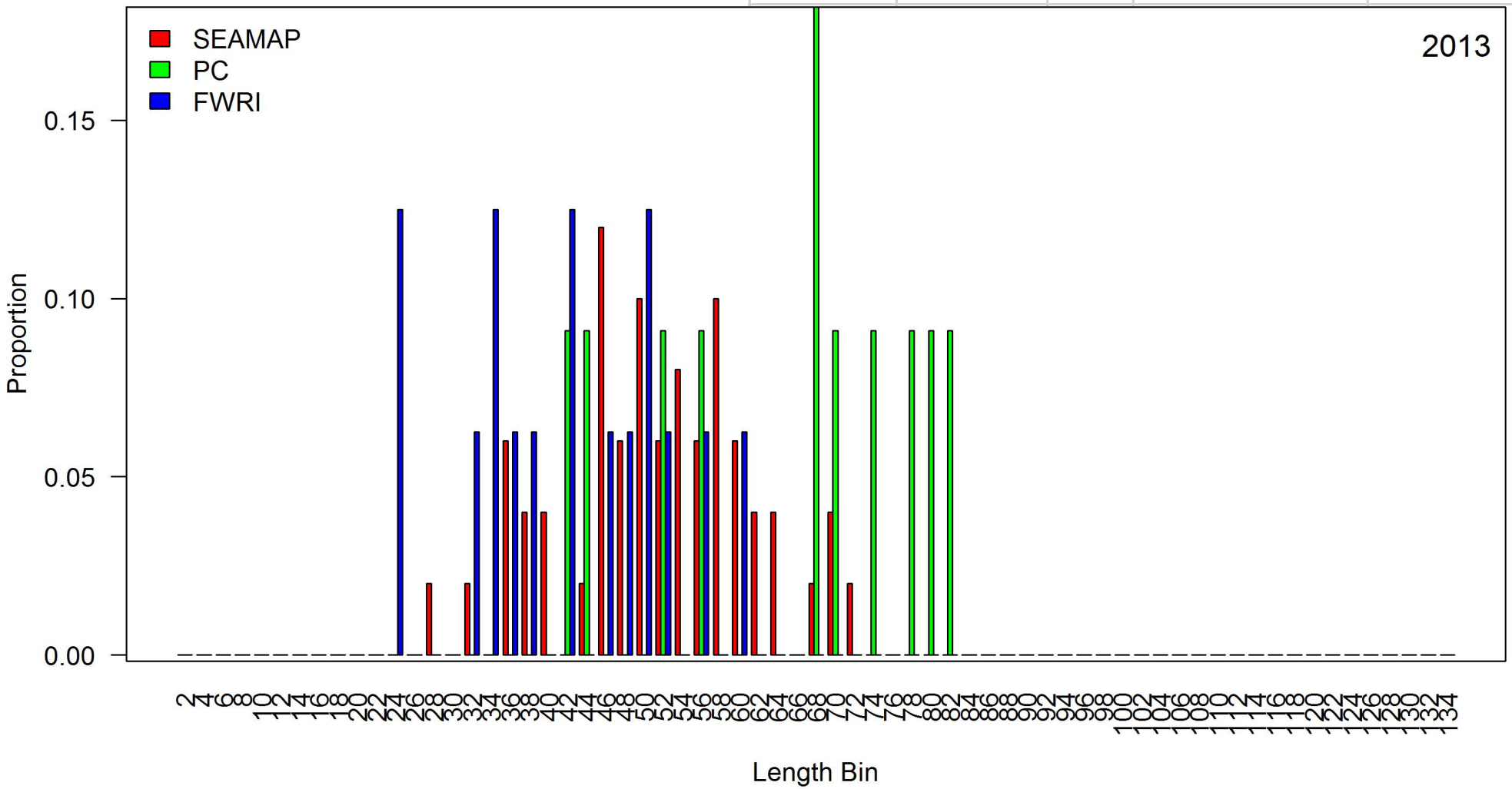
| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2011 | 45 | 45 | 70 | 160 |



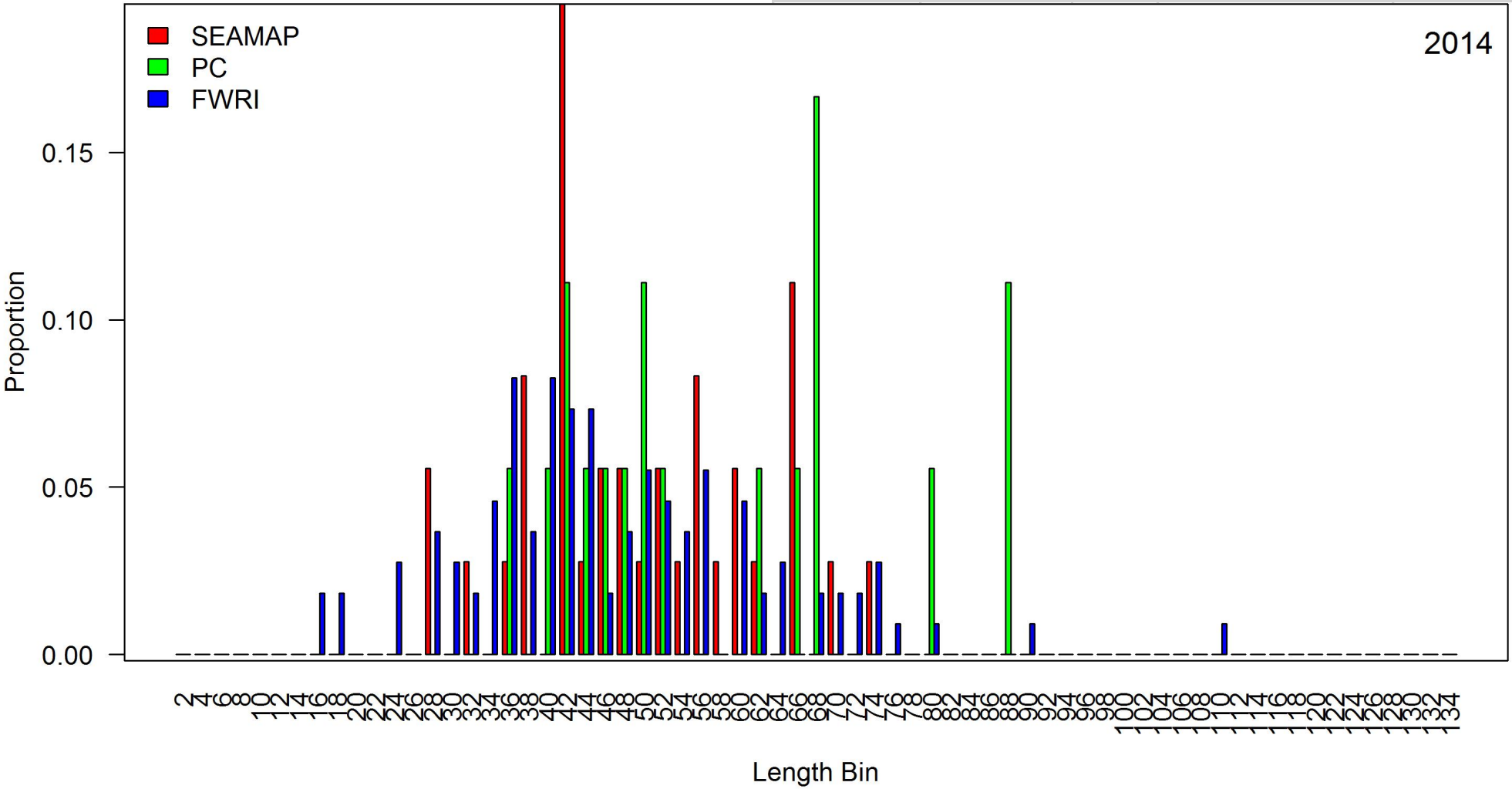
| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2012 | 63 | 39 | 91 | 193 |



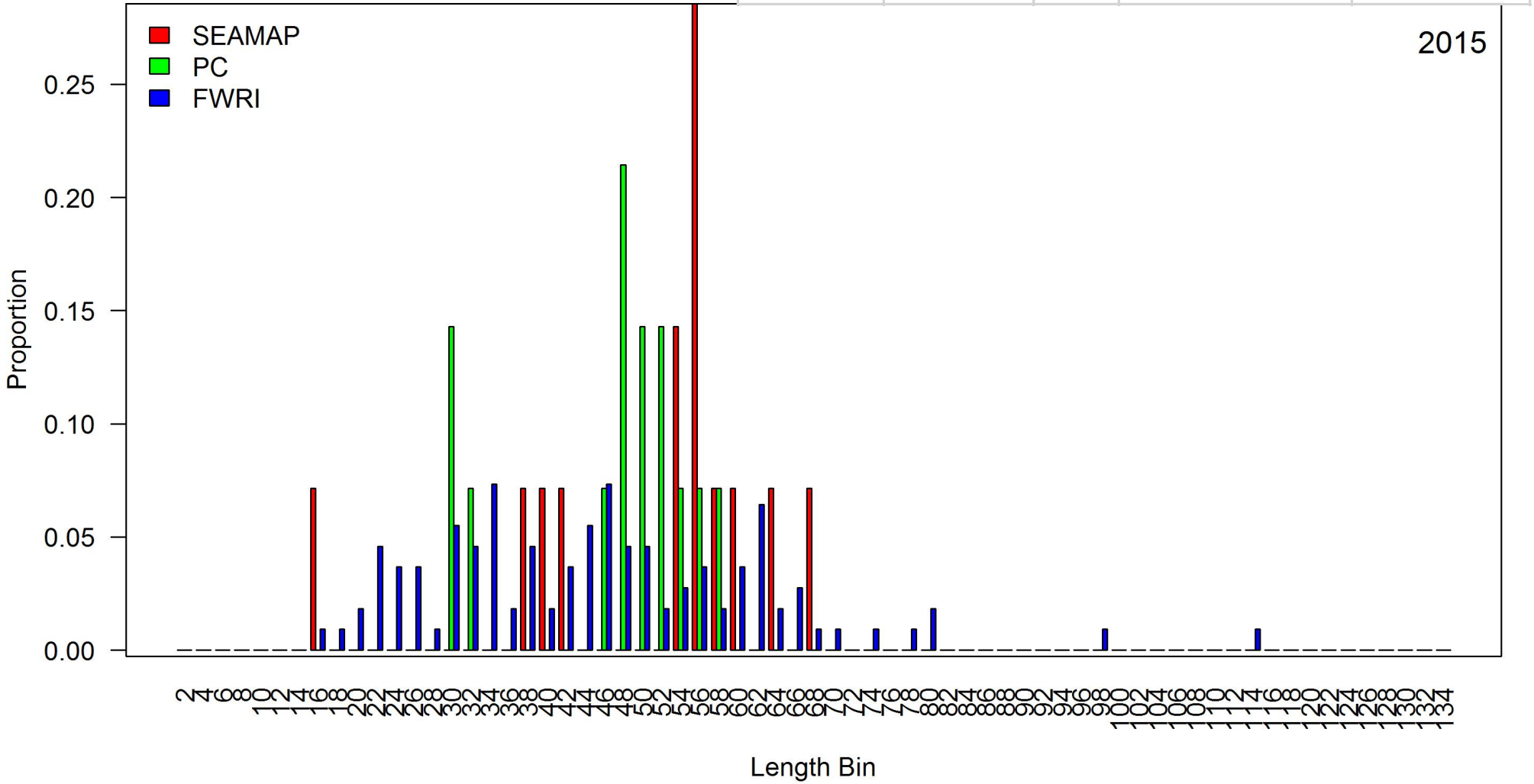
| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2013 | 16 | 11 | 50 | 77 |



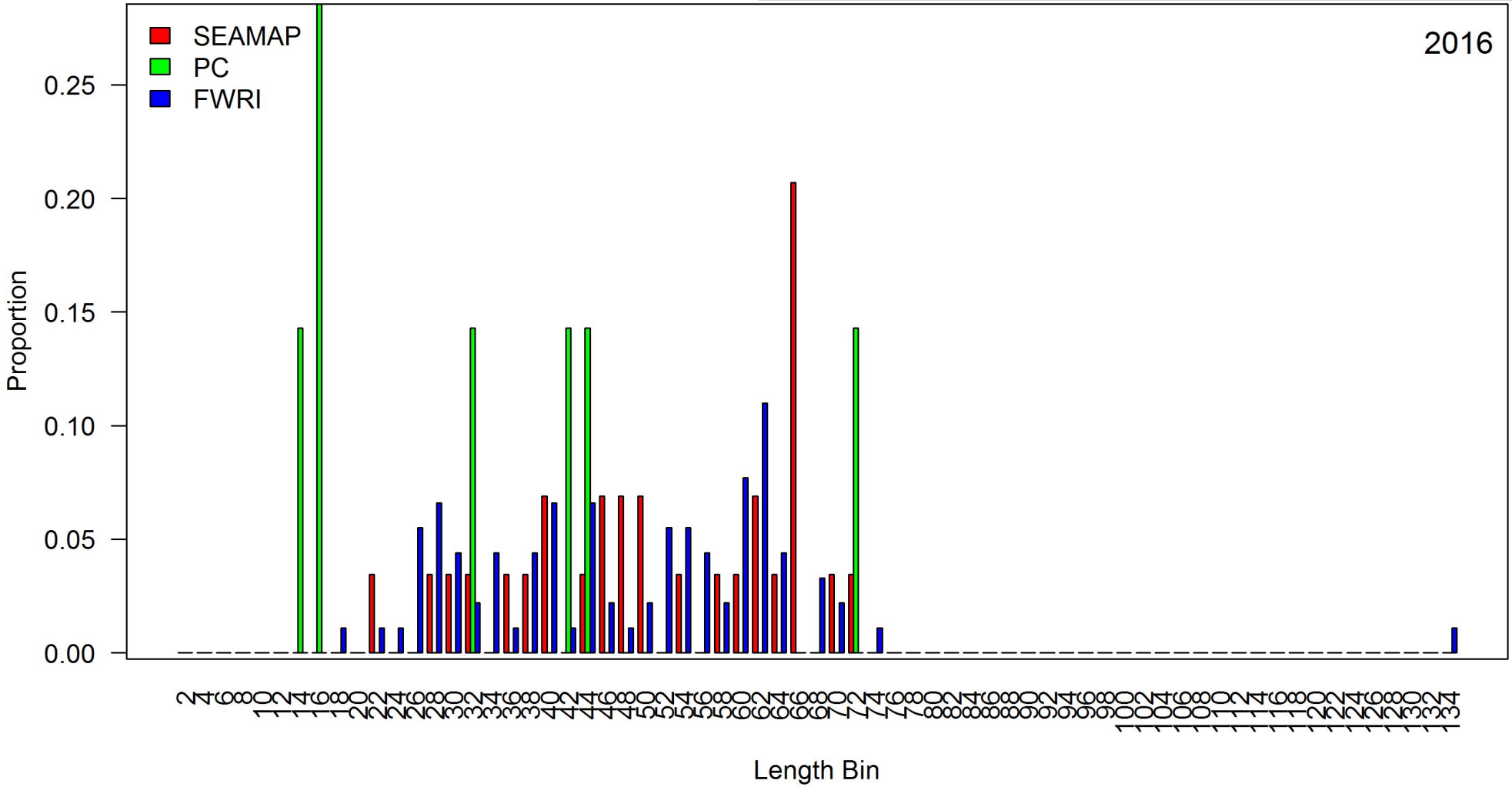
| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2014 | 109 | 18 | 36 | 163 |



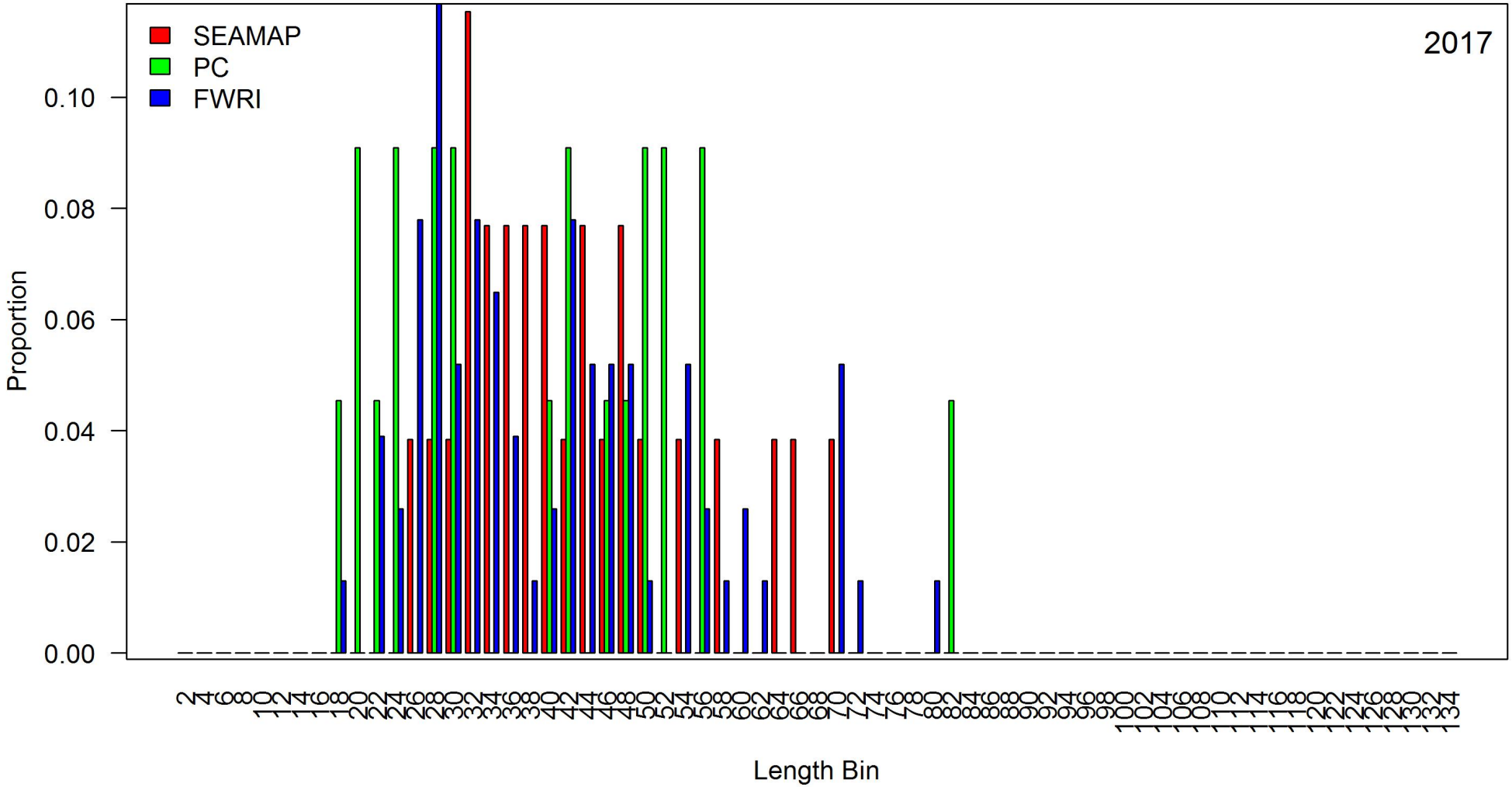
| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2015 | 109 | 14 | 14 | 137 |



| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2016 | 91 | 7 | 29 | 127 |



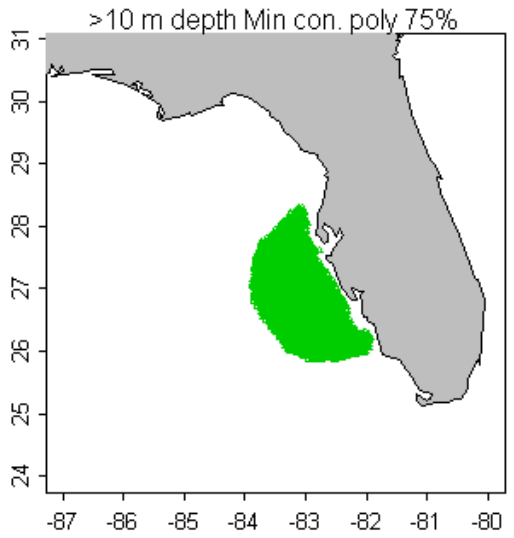
| Year | FWRI | PC | SEAMAP | TOTAL |
|---|---|---|---|---|
| 2017 | 77 | 22 | 26 | 125 |

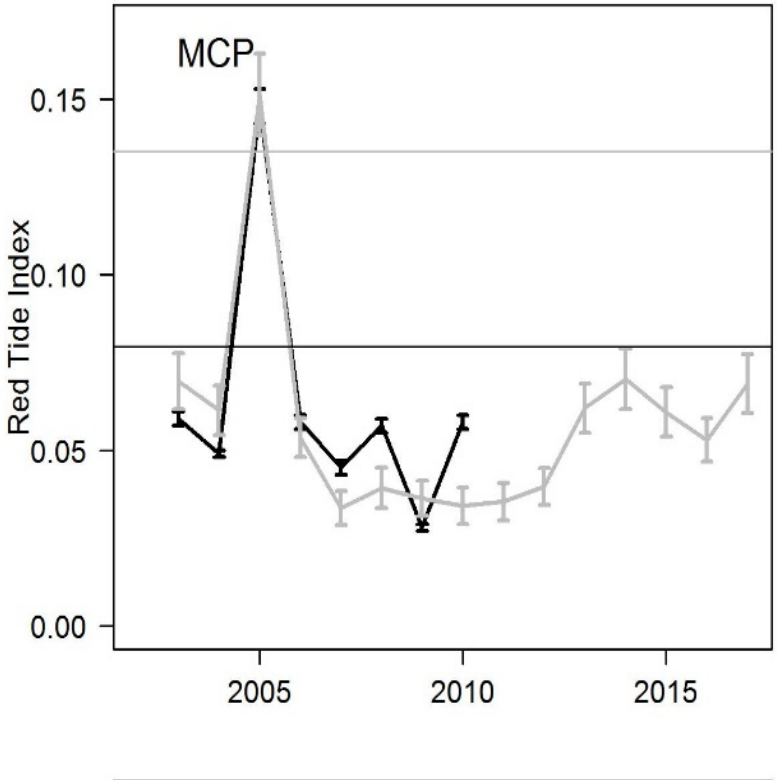


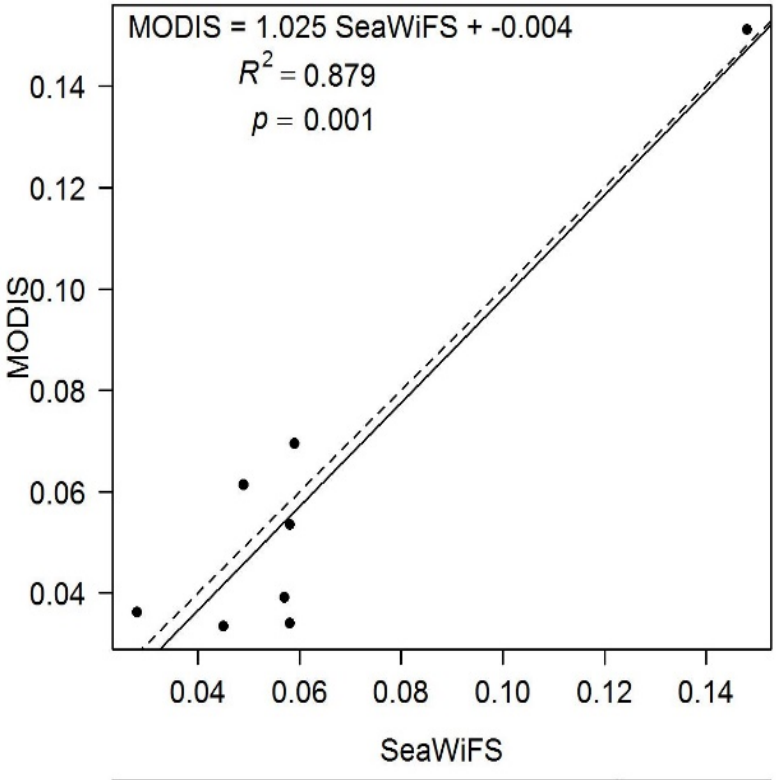
# Red Tide

# Red Tide

- Updated indices of red tide severity using MODIS data (originally presented in Walter et al. 2013)



# New Data

# Red tide

- Available data:
  - Ecosystem analysis using satellite data nad harmful algal bloom (HAB) cell counts from FWRI
    - SEDAR61-WP-06
  - Driggers et al. (2015) – mass mortality
  - Stakeholder observations

# Ecosystem analysis

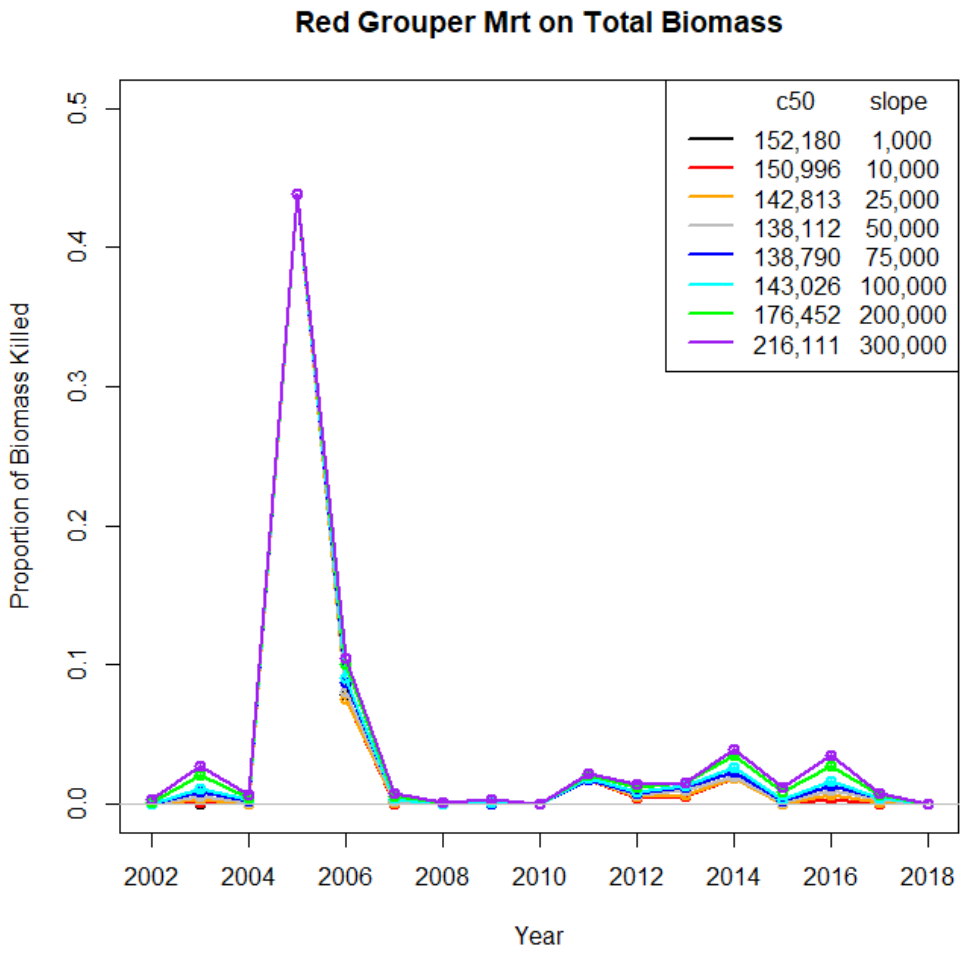
- Objective: estimate the mortality rate of red grouper caused by red tides from 2002-2017

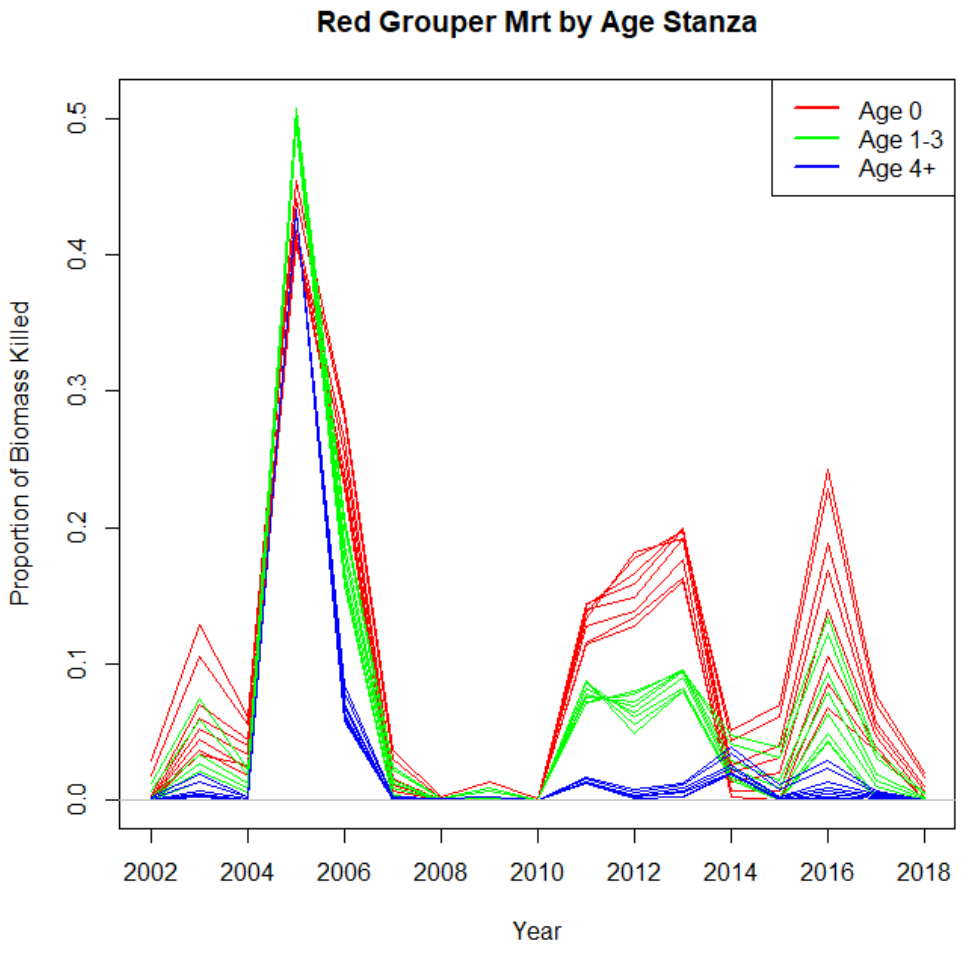
  - Spatial extent and duration – satellite imagery
  - Severity – cell concentration samples
  - Species distribution patterns – ecosystem model
  - Mortality – logistic response function

Chagaris, SEDAR61-WP-06

# Ecosystem analysis

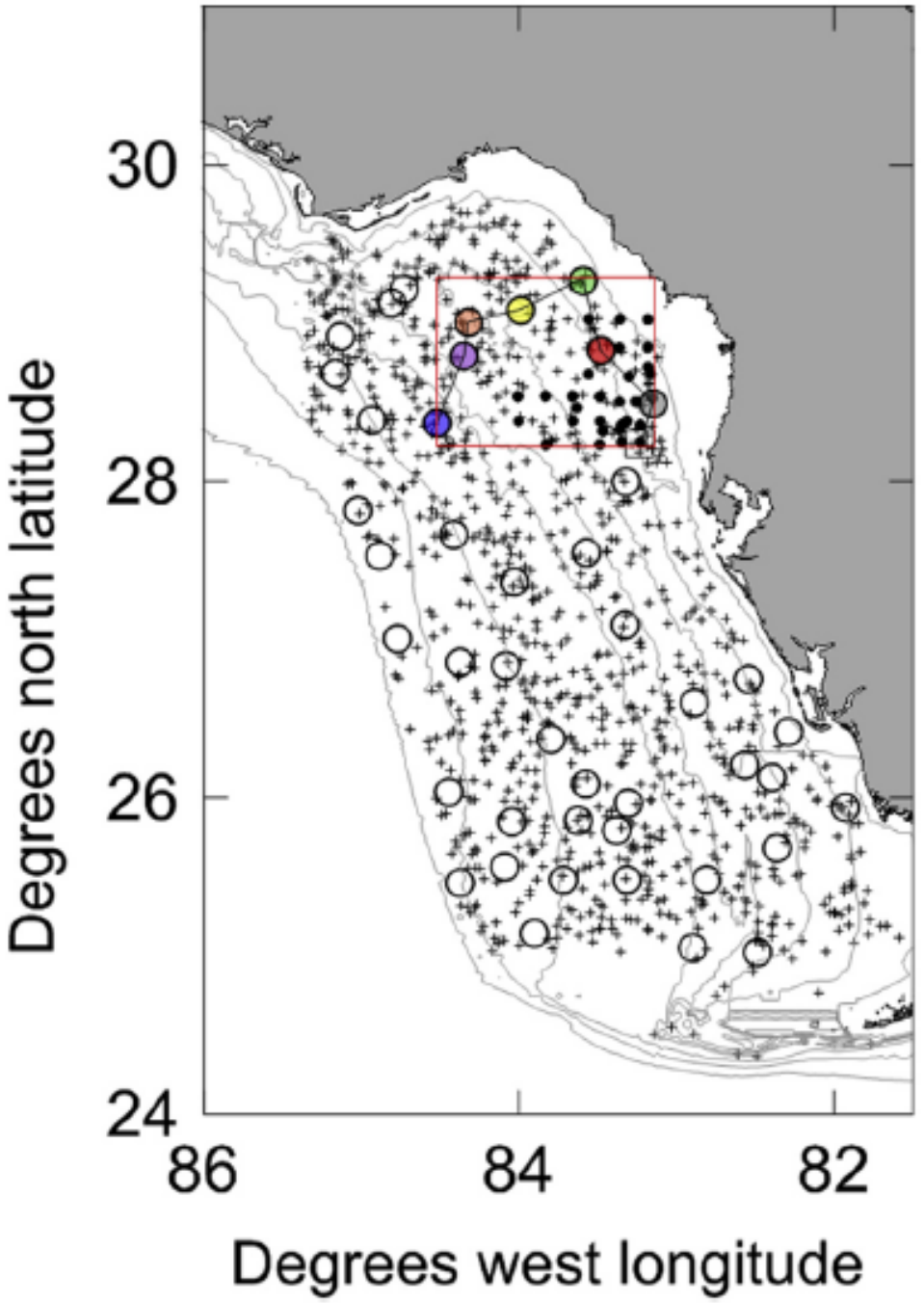
Chagaris, SEDAR61-WP-06



# Driggers et al. 2015

- Red grouper captured in area in all years except 2014
- Captured at least 30X more frequently than other snapper/groupers between 1995-2013
- Hypothesized many of the highly decomposed fish observed were red grouper



# Groupers and red tide: 2018

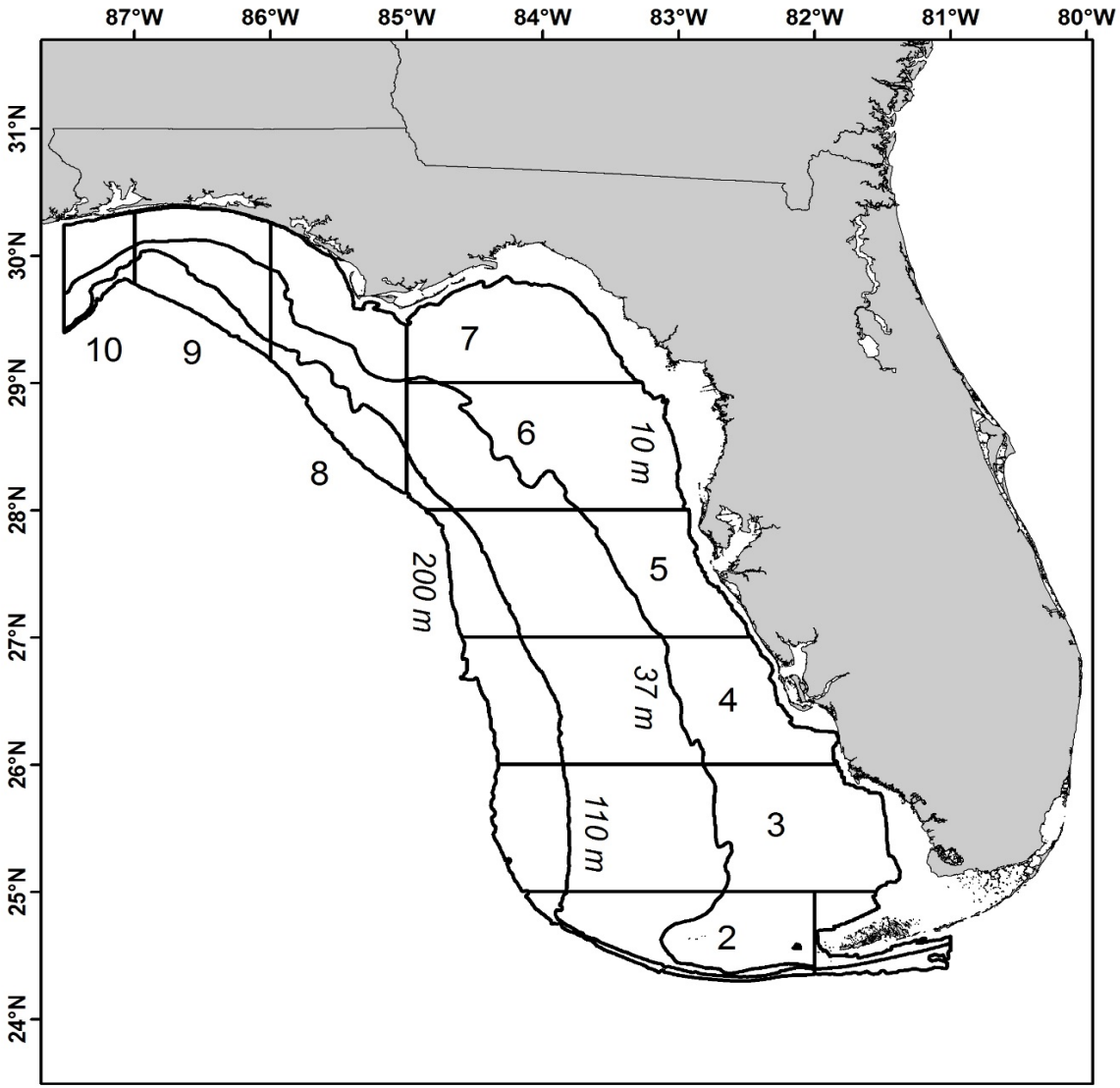
Photo Credit: Ed Walker, Venice Area

Photo Credit: Ed Walker, Venice Area

- News reports of mass mortalities of sea turtles, dolphins, manatees, groupers, sport fish, coastal fish, and a whale shark

# FWRI Surveys: Repetitive Time Drop & Vertical Longline

- Stratified-random sampling design
- Grids sampled:
  - 2014-15: 4, 5, 9, 10
  - 2016-17: 2-10
- Depths sampled:
  - Nearshore (9–36 m)
  - Offshore (37–109 m
  - Deep (110–180 m)

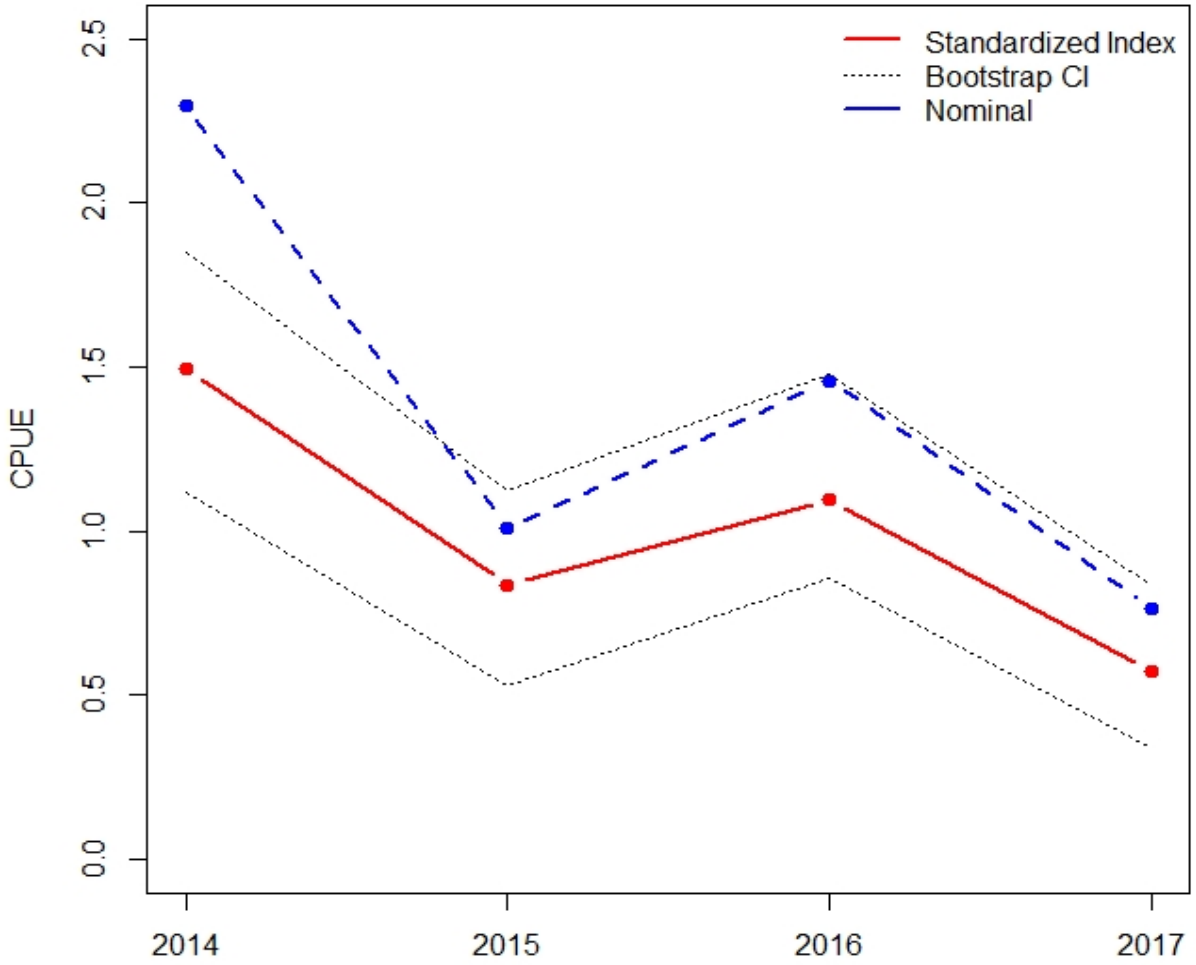


# FWRI Repetitive Time-Drop

| Year | Nom | N | Proportion positive | Standardized Index | CV |
|---|---|---|---|---|---|
| 2014 | 2.30 | 108 | 0.42 | 1.49 | 0.13 |
| 2015 | 1.01 | 105 | 0.33 | 0.84 | 0.19 |
| 2016 | 1.46 | 98 | 0.49 | 1.10 | 0.14 |
| 2017 | 0.76 | 76 | 0.34 | 0.58 | 0.22 |

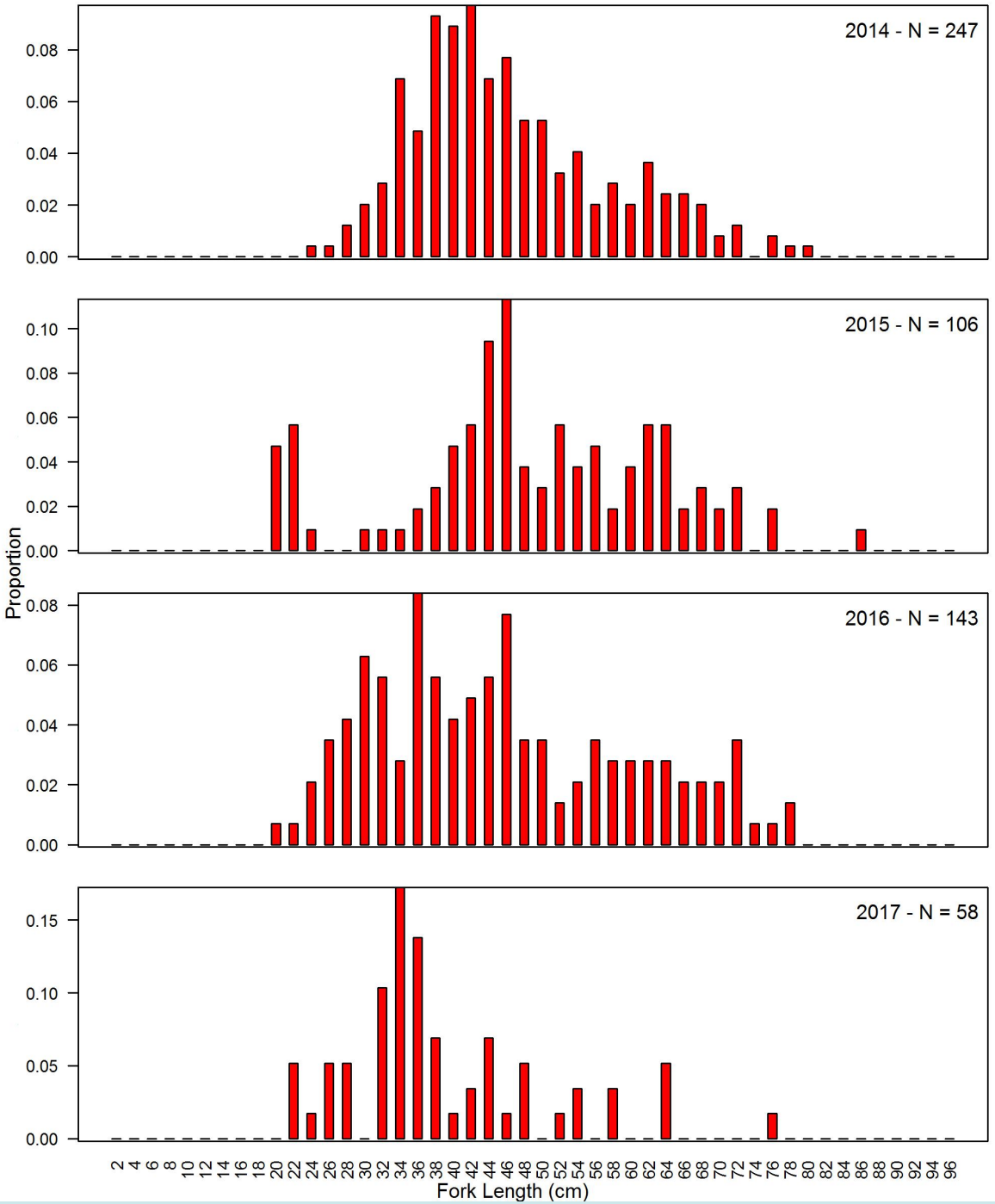
## Index

- Includes data from zones 4, 5, 9, and 10 from 2014 through 2017 for consistency
- Relatively short temporal extent



# FWRI
# Repetitive Time-Drop

# length composition

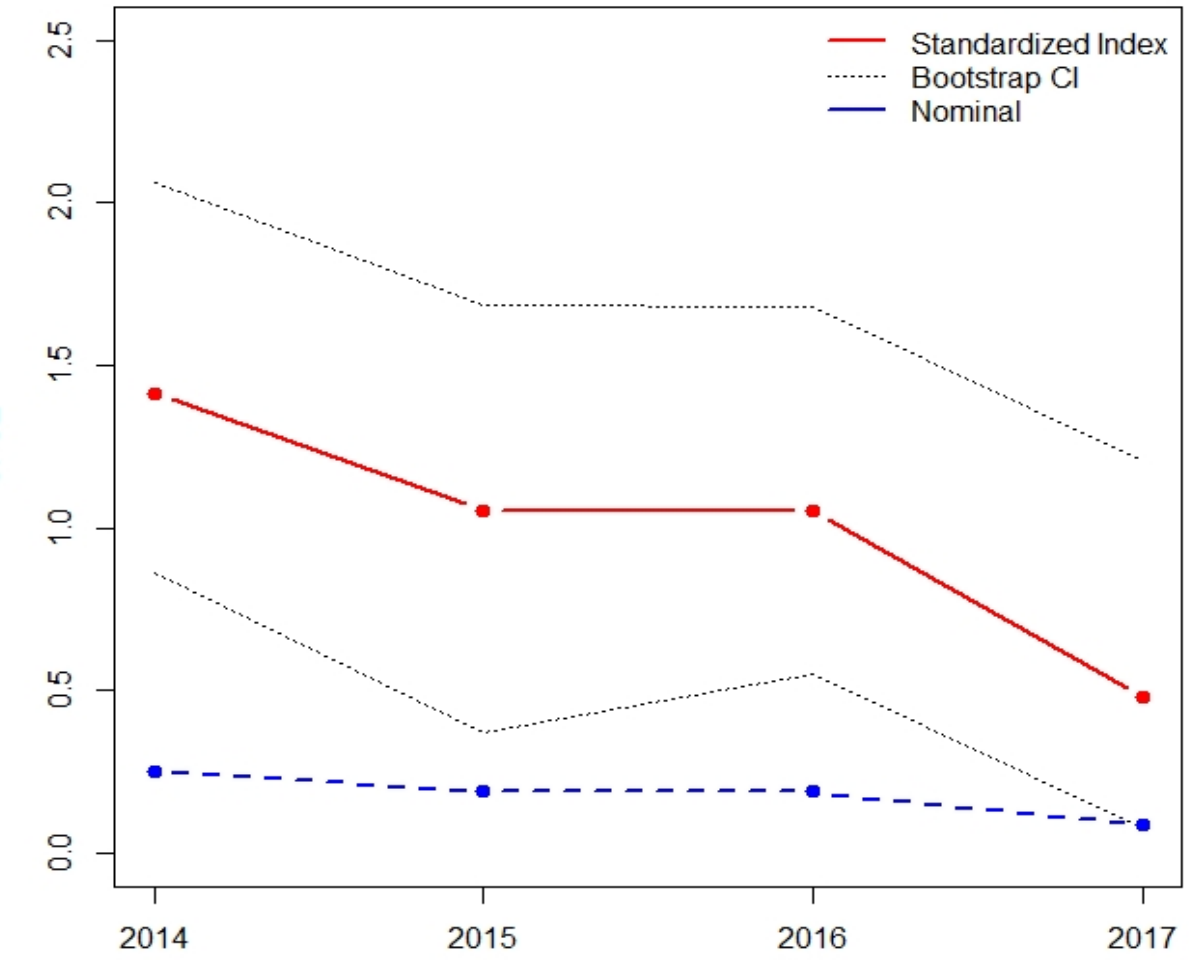


# FWRI Vertical Longline

| Year | Nom | N | Proportion positive | Standardized Index | CV |
|---|---|---|---|---|---|
| 2014 | 0.25 | 114 | 0.15 | 1.41 | 0.22 |
| 2015 | 0.19 | 100 | 0.09 | 1.06 | 0.34 |
| 2016 | 0.19 | 95 | 0.15 | 1.05 | 0.26 |
| 2017 | 0.08 | 81 | 0.04 | 0.48 | 0.60 |

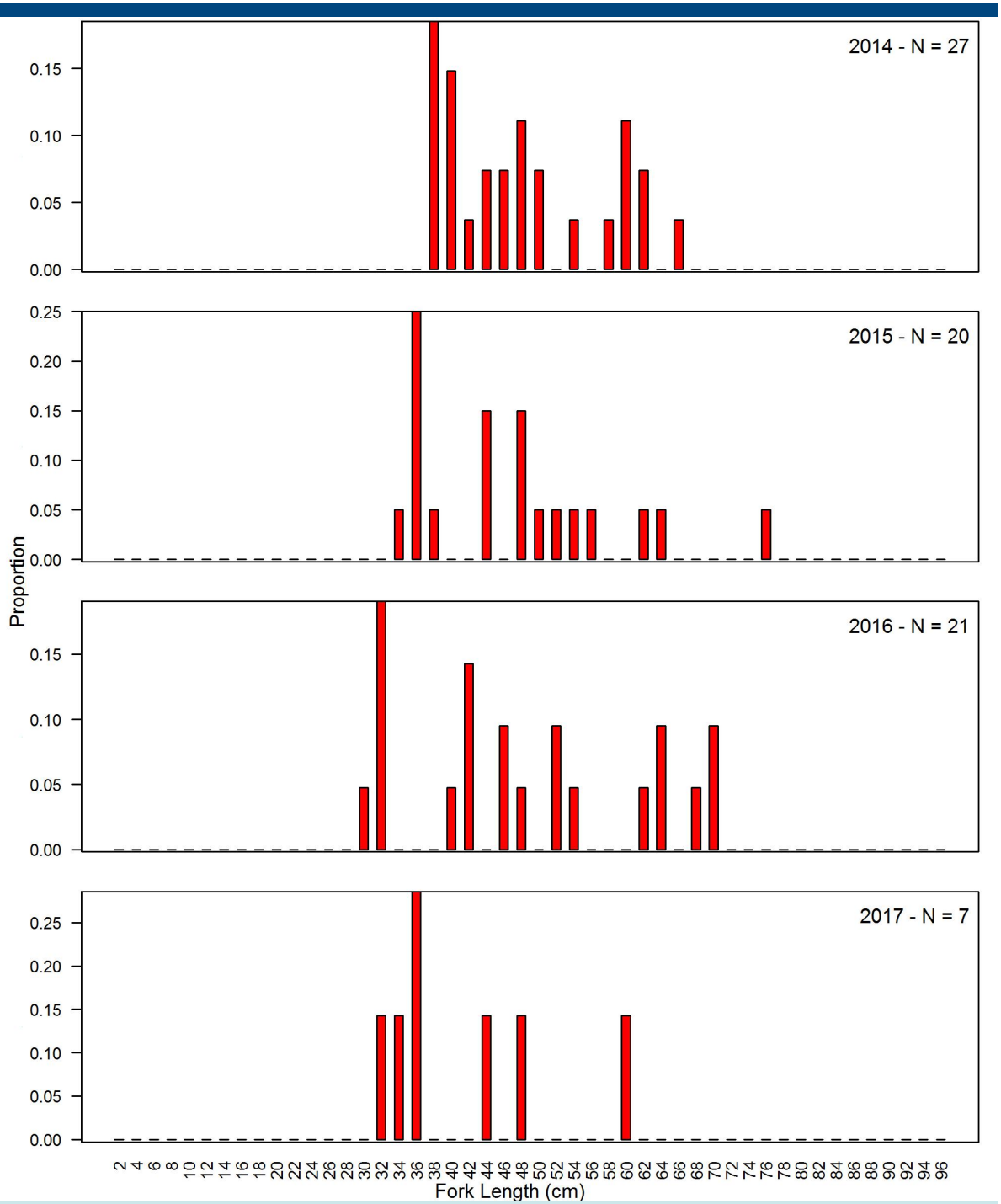
## Index

- Includes data from zones 4, 5, 9, and 10 from 2014 through 2017 for consistency
- Relatively short temporal extent



# FWRI
# Vertical Longline

# length composition



# Continuity Model Structure

# Red grouper continuity model configuration

- 1993 - 2013
- 1 area, 1 season model
- Combined gender model
- Maturity, protogyny, and fecundity a function of age
- von Bertalanffy growth
- Lorenzen natural mortality
- Beverton-Holt spawner-recruitment relationship
  - Steepness fixed (h = 0.99)

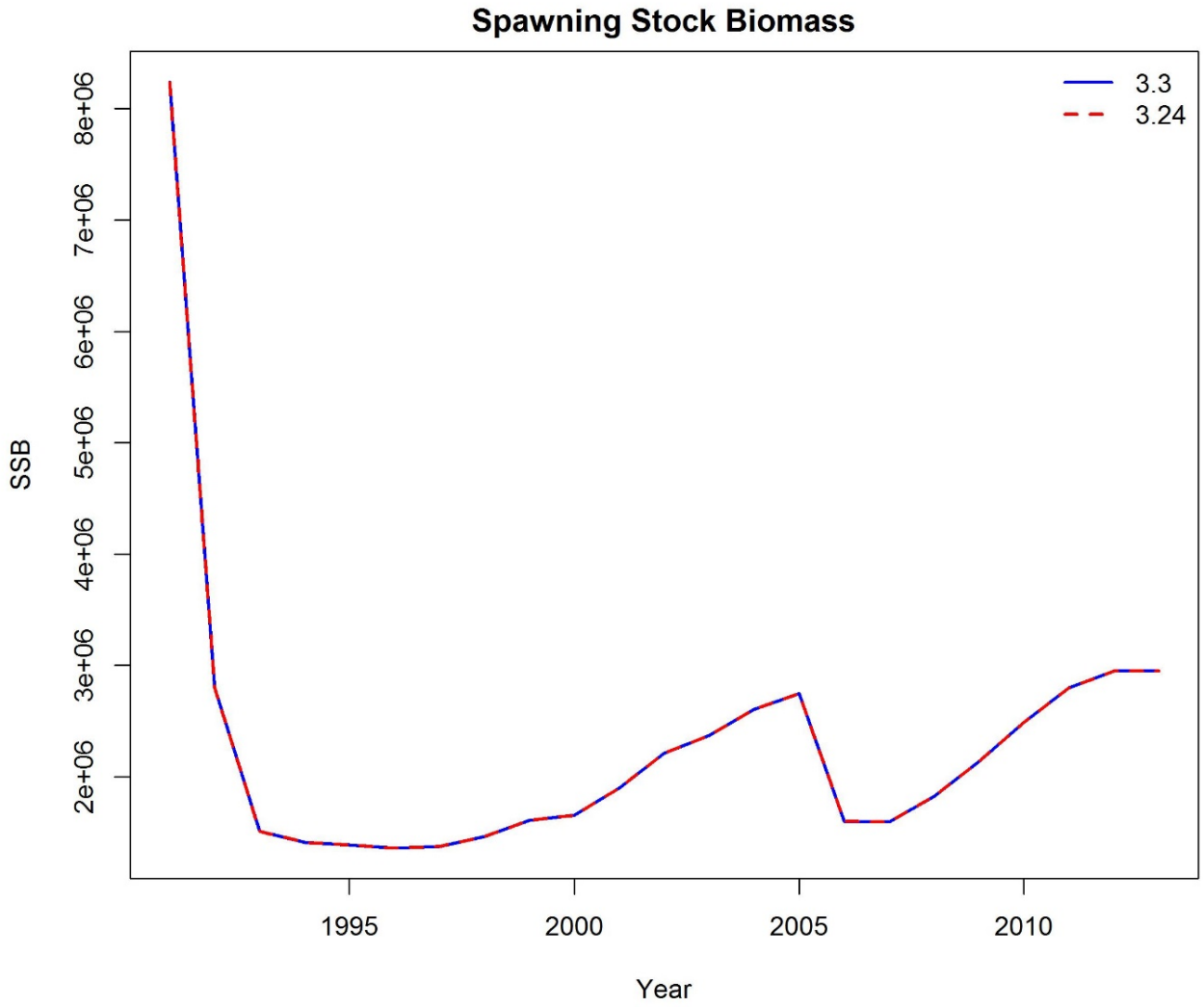
# Red grouper continuity model configuration

- 5 fishing fleets – landings and discards
- 3 fishery-independent indices of abundance
- Red tide mortality in 2005
- Age-based selectivity
  - Fleets
- Length-based selectivity
  - Fishery-independent surveys
- Time-varying retention to account for changes in regulations

# Proposed Model Changes

# Should we move forward with SS3.3?

- SEDAR 42 used Stock Synthesis version 3.24
- Replicated SS3.24 model in SS3.3
  - Get identical results



# Revisit Terms of Reference:

2. Evaluate and document the following specific changes in input data or deviations from the benchmark model previous assessment model.

- Review existing methods for deriving discard numbers and discard rates and improve methods as appropriate
- Explore the effect of the IFQ program on commercial CPUE, and the sensitivity of model results to plausible alternative commercial CPUE series
- Review analytical methods for the combined video index from the FWRI, Pascagoula, and Panama City video surveys
- Explore the potential effects of red tide with consideration of past red tide events and those of 2014 and 2015
- Reconsider the start year of the assessment model
- Evaluate size-based selectivity
- Investigate the use of new fishery-independent hook-gear survey data collected by FWC

# New data

- Incorporate FWRI repetitive time drops in base model

# Model exploration – indices

- Commercial IFQ
- Use old (through 2013) vs updated headboat index (through 2017) (assumptions may not be constant over entire time series)
- CV Weighting

# Model exploration – red tide

- With and without age-specific red tide related cumulative effects
  - Red tide affecting mortality
  - Red tide affecting catchability

# Model exploration – start year

- Start model back in time
  - Initial SEDAR 42 model started in 1986
  - Final SEDAR 42 model started in 1993

- Historical catches available
  - Commercial back to 1963 (HL)
  - Recreational recreated back to 1945
    - Isely et al. 2014 – SEDAR42-DW-16

# Model exploration – composition & selectivity

- Explore different capping practices on composition
- Explore size-based selectivity for fisheries:
  - SEDAR 42:
    - Age-based for fisheries
    - Length-based for fishery-independent

# Research Recommendations

- Commercial indices post-IFQ
- Commercial indices update (explore effort variable)
- Headboat index update (investigate assumptions)
- Hermaphroditism parameterization
- Model and data higher stratification
- Red Tide (Can we look into higher temporal resolution)?
- Fishy survey
  - Explore positive/negative perception based on fleet (comm vs rec)

# Projections

# Projection assumptions

- Assume fishing patterns (selectivity, discard mortality rate, retention rates, etc.) of each fleet same as recent years
- Catch allocation by fleet:
  - 76% Commercial
  - 24% Recreational
- Assume future recruitments are similar to average of 1986-2017 recruitments
- Influence of red tide in 2018

# Projection scenarios

- Evaluate (preliminary, to be modified as appropriate)
  1. Landings fixed at 2016 target.
  2. FOY= 75% FMSY (project when OY will be achieved)
  3. FREBUILD (if necessary)
  4. F=0 (if necessary)
  5. Equilibrium yield at FMSY

# Next steps

# Webinar #1 (week of November 26th)

- Discuss general changes to recreational data following the MRIP revisions
- Review:
  - MRFSS landings and discards
  - Headboat discards
  - MRFSS Index of abundance
  - Recreational age composition
  - Outstanding data issues from workshop
    - Commercial indices
    - Video length composition

# Assessment Schedule

- Delay due to revised MRIP data

Recreational data products deadline & Working papers to SEDAR Staff ..... November 16, 2018

Assessment webinar I ..... *week of November 26th, 2018*
Assessment webinar II ..... *week of January 7th, 2019*
Assessment webinar III ..... *week of February 11th*, 2019*
Assessment webinar IV ..... *week of March 25th, 2019*
Assessment webinar V ..... *week of April 29th, 2019*

Assessment Report Draft to panel for review: ..... May 24, 2019
Assessment Report comments due to editors: ..... June 7, 2019
Assessment Report to SEDAR staff: ..... June 14, 2019
Complete Assessment Report Submitted to Council: ..... June 24, 2019

# Questions?

# Thank you for your attention!

# SEDAR 61 Gulf of Mexico Red Grouper Stock Assessment:

# Data and Assessment Workshop Day 2

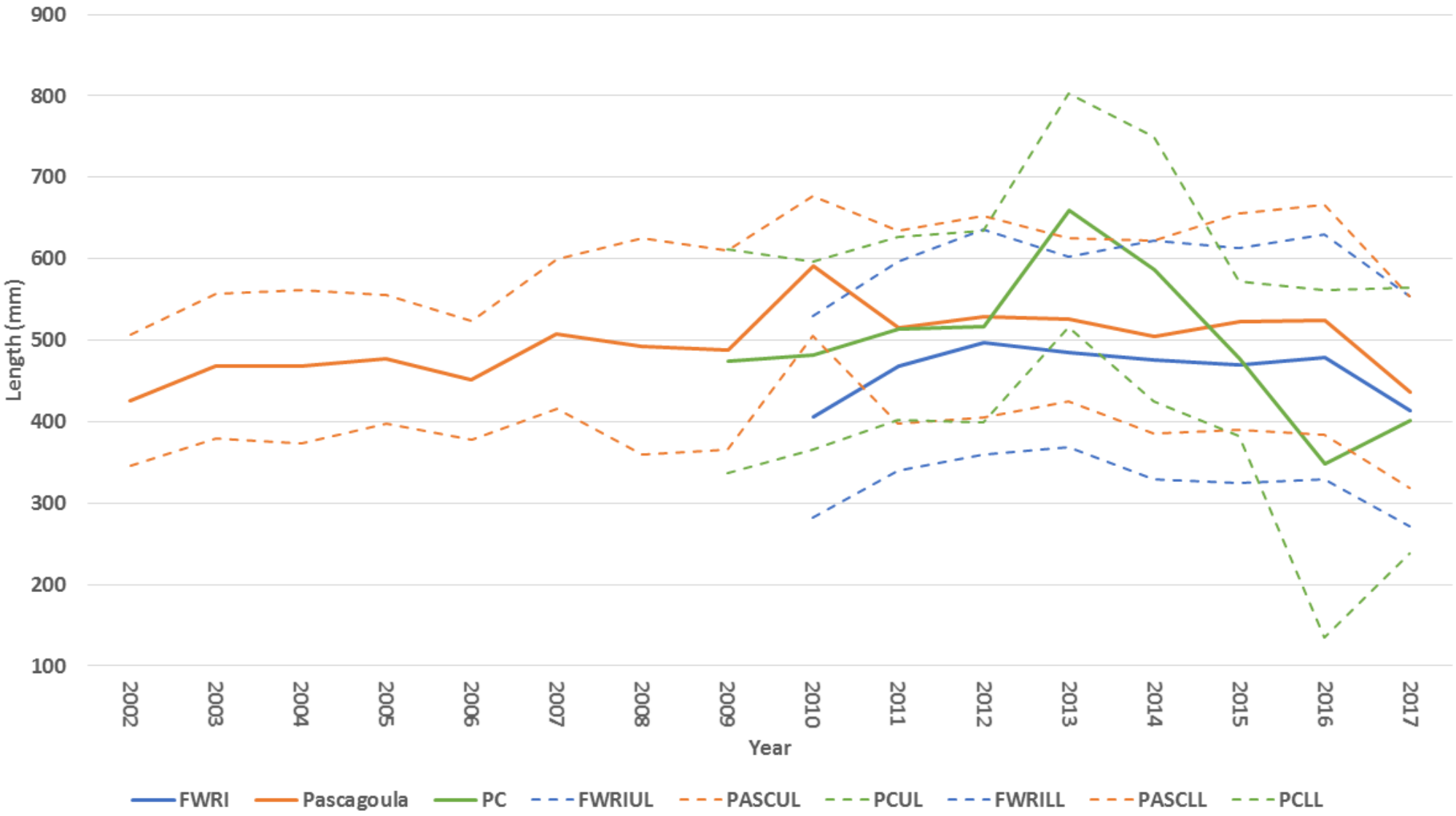
Skyler R. Sagarese
Matthew W. Smith

September 11-13, 2018

# Length composition

| Topic | To-Do |
| --- | --- |
| Video Survey Length Data | Do we need to reweight length data?<br>Plot means and S.D. in mean length by lab |

# Video survey



# Video survey

| | Sample sizes | | | |
|---|---|---|---|---|
| Year | FWRI | Pascagoula | PC | Total |
| 2002 | | 28 | | 28 |
| 2003 | | 22 | | 22 |
| 2004 | | 72 | | 72 |
| 2005 | | 108 | | 108 |
| 2006 | | 95 | | 95 |
| 2007 | | 73 | | 73 |
| 2008 | | 32 | | 32 |
| 2009 | | 64 | 39 | 103 |
| 2010 | 19 | 26 | 38 | 83 |
| 2011 | 42 | 70 | 45 | 157 |
| 2012 | 63 | 91 | 39 | 193 |
| 2013 | 16 | 50 | 11 | 77 |
| 2014 | 107 | 36 | 18 | 161 |
| 2015 | 96 | 14 | 14 | 124 |
| 2016 | 101 | 29 | 7 | 137 |
| 2017 | 77 | 26 | 22 | 125 |
| | | | | |
| Grand Total | 521 | 842 | 233 | 1596 |

# Red tide

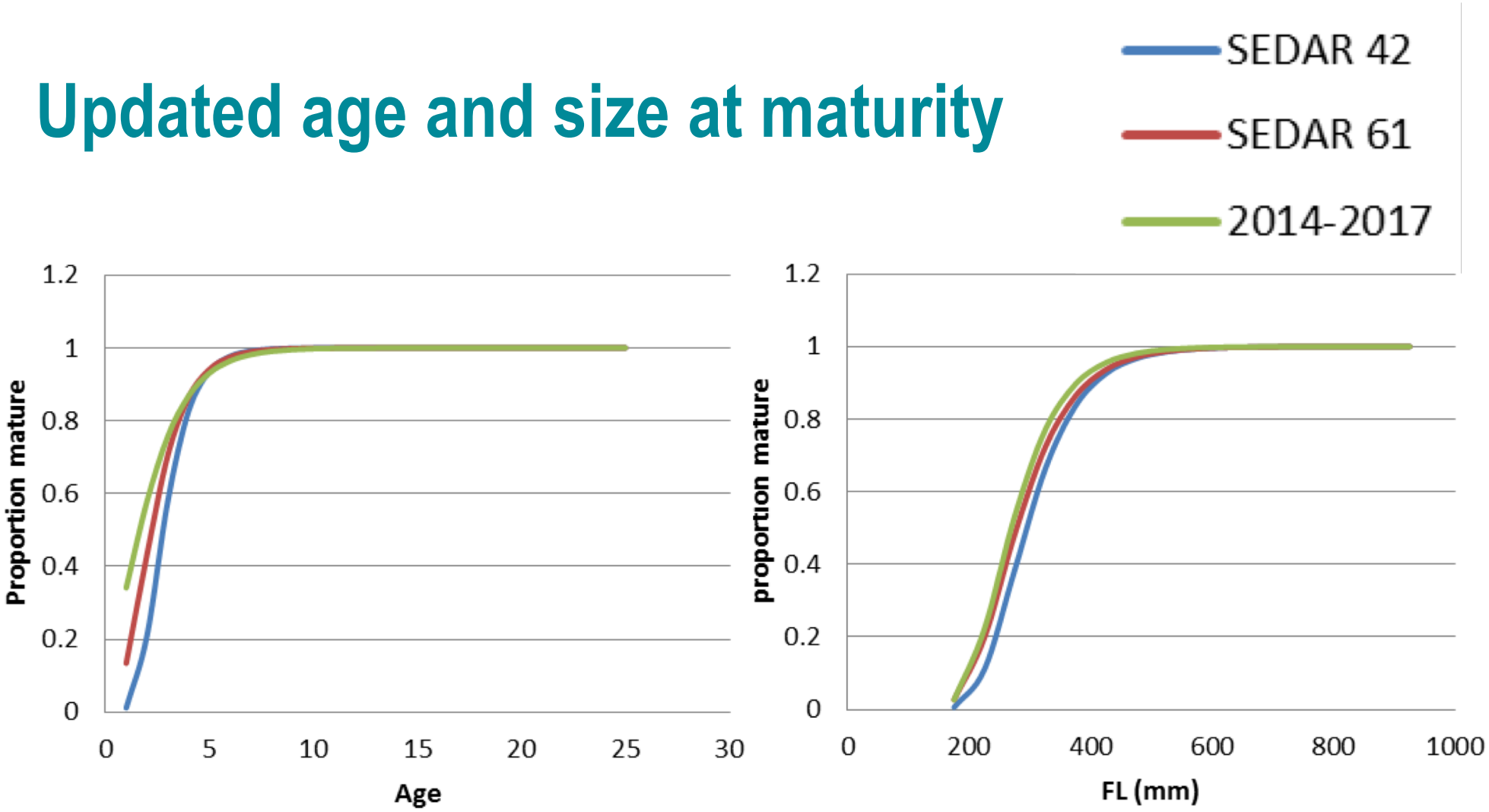
| Topic | To-Do |
| --- | --- |
| Red Tide | Do we call 2014 a red tide year?<br>Do we try to accommodate how it may have affected specific size classes?<br>What about 2018?<br>Do we modify modeling approach? |

# Afternoon

# Life history

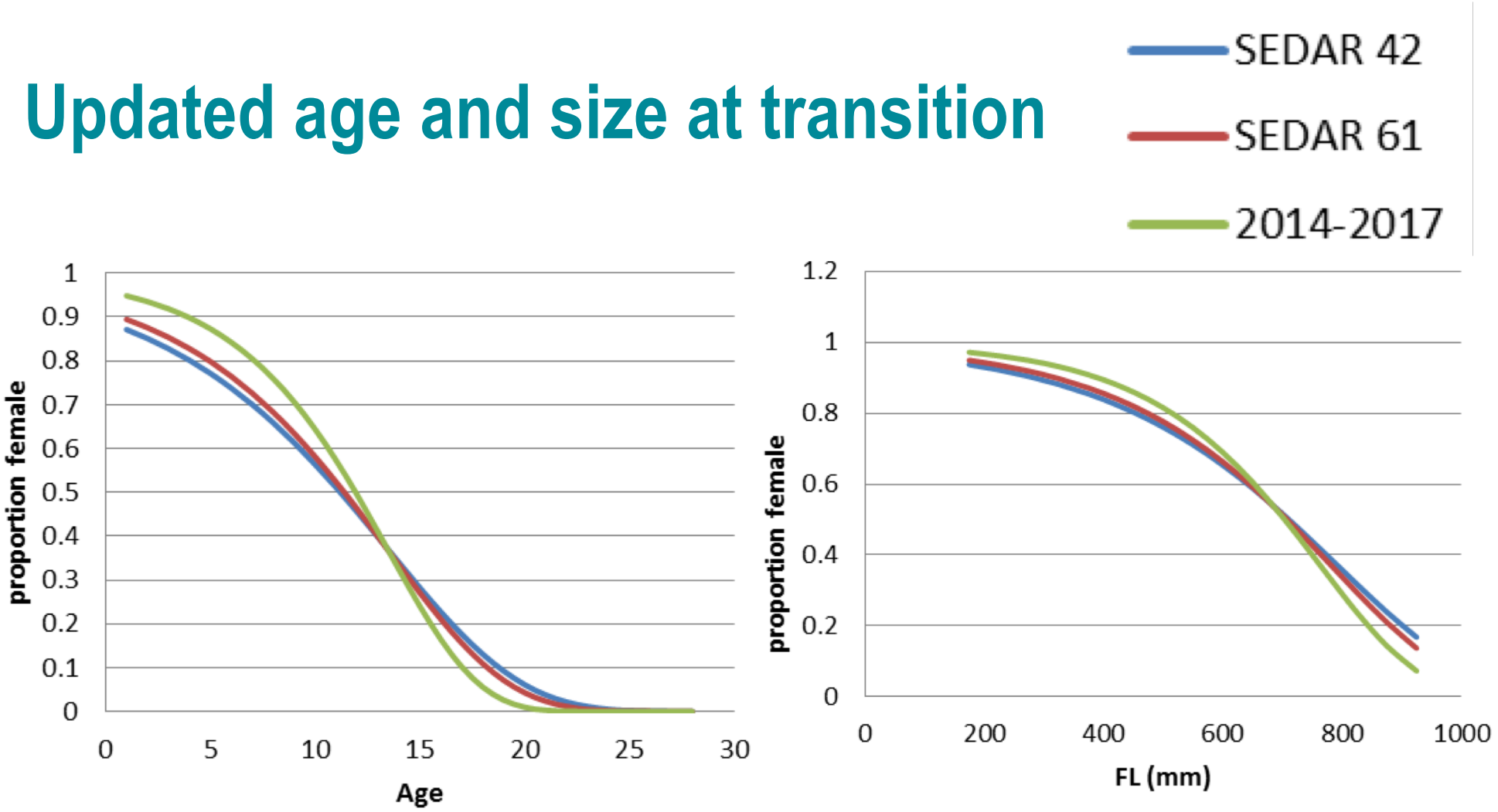
| Topic | To-Do |
| --- | --- |
| Maturity/Transition | Combine data from NOAA and FWRI? |

# Updated age and size at maturity




| Source | Age at 50% Maturity | Size at 50% Maturity |
|---|---|---|
| SEDAR 61 | 2.2 years | 278 mm FL |
| SEDAR 42 | 2.8 years | 292 mm FL |

# Updated age and size at transition




| Source | Age at Transition | Length at Transition |
|---|---|---|
| SEDAR 61 | 11.4 years | 708 mm FL |
| SEDAR 42 | 11.2 years | 707 mm FL |

# Life history

| Topic | To-Do |
| --- | --- |
| Batch Fecundity | Convert length function to age function or convert proportions by sex and proportion mature to length based |
| SSB Metric | Discuss with input from FWRI |

# New data

| Topic | To-Do |
| --- | --- |
| FWRI vertical line survey & repetitive time drop | Explore selectivity |
| Fishy survey | **Use as supplemental resource** |

# Outstanding issues: start year

- Use historical catch histories reconstructed for SEDAR 42

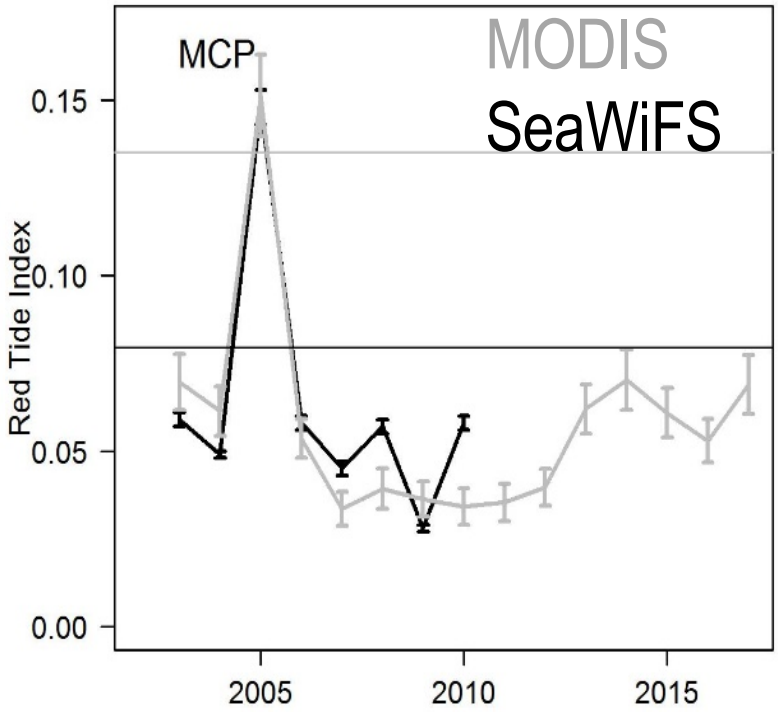
# Outstanding issues: red tide

- Red tide impressions:
  - Severity of 2005 vs 2014 vs 2018
    - 2005 event = 10
    - 2014 event = ?
    - 2018 event =?

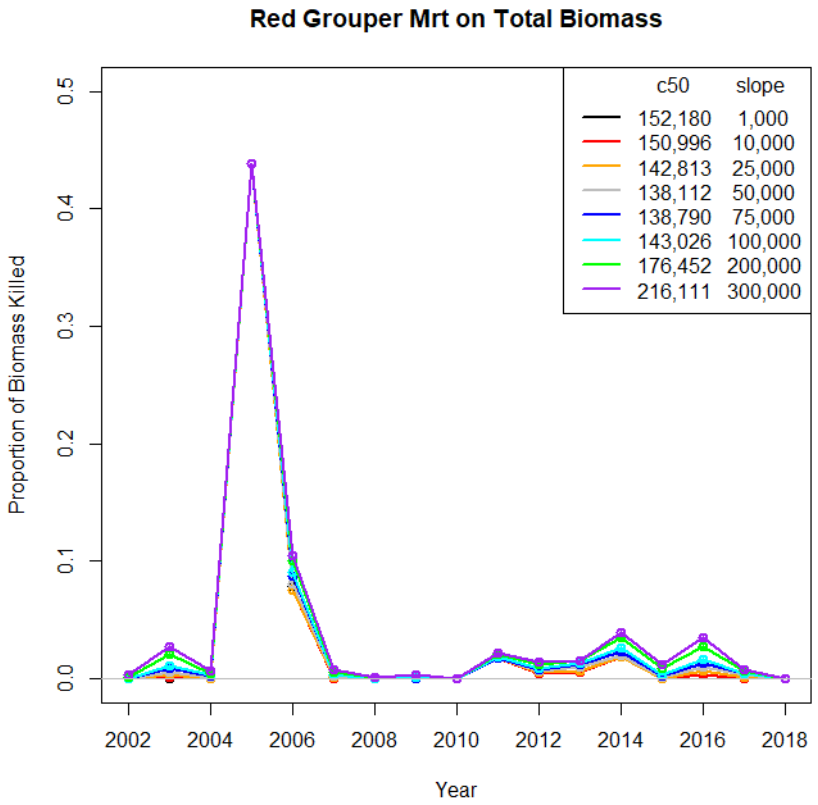
- Annual maps of fishery-independent catches for comparison to red tide spatial distribution?

# Outstanding issues: red tide

- Which red tide index do we use in assessment?




SEDAR61-WP-07




SEDAR61-WP-06