Methods for examining in-season behavior of the cumulative discard estimation

Daniel W. Linden, Ph.D.

Greater Atlantic Regional Fisheries Office

National Marine Fisheries Service

October 31, 2016

NOAA FISHERIES

Data Sources (2010–2016)

1. Total catch: K
   - Dealer, VTR
   - merged in DMIS

2. Observed catch/discard: k, d
   - Northeast Fisheries Observer Program (NEFOP)
   - At-Sea Monitors (ASM)

SEAFOOD DEALER INC.

Source: NOAA/GARFO

FISHERIES OBSERVER

Source: NOAA/NEFOP

Discard estimation – ratio

- Follows Standardized Bycatch Reporting Methodology
- Ratio estimator: observed discard/kept
- Extrapolate observed to unobserved trips
- Stratification

$$r_{jh} = \frac{\sum_{i=1}^{n_h} d_{jih}}{\sum_{i=1}^{n_h} k_{ih}} \qquad \widehat{D}_j = \sum_{h=1}^{L} K_h r_{jh}$$

Wigley et al. (2007) - SBRM

NOAA FISHERIES

Discard estimation – uncertainty

- Variance in observed discards
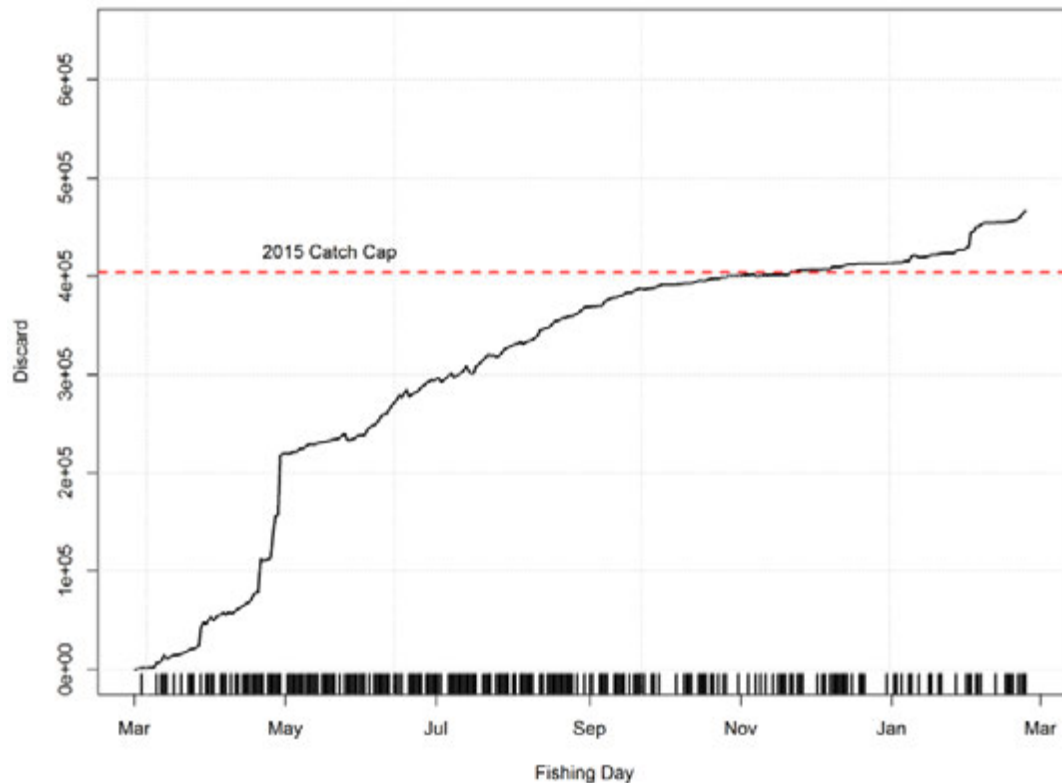- Sample sizes
- Precision in estimates (CV)

$$V(\widehat{D}_j) = \sum_{h=1}^{L} K_h^2 \left(\frac{N_h - n_h}{n_h N_h}\right) \frac{1}{\left(\frac{\sum_{i=1}^{n_h} k_{ih}}{n_h}\right)^2} \left[\frac{\sum_{i=1}^{n_h}(d_{jih}^2 + r_{jh}^2 k_{ih}^2 - 2r_{jh}d_{jih}k_{ih})}{n_h - 1}\right]$$

$$CV(\widehat{D}_j) = \frac{\sqrt{V(\widehat{D}_j)}}{\widehat{D}_j}$$

Wigley et al. (2007) - SBRM

Discard estimation – cumulative

- Estimated weekly as trips occur
- Function of $[N, K]$ and $[n, r]$

Discard estimation – transition rates

- Adjust early-season discard rate

- Use information from previous year

- Two approaches:

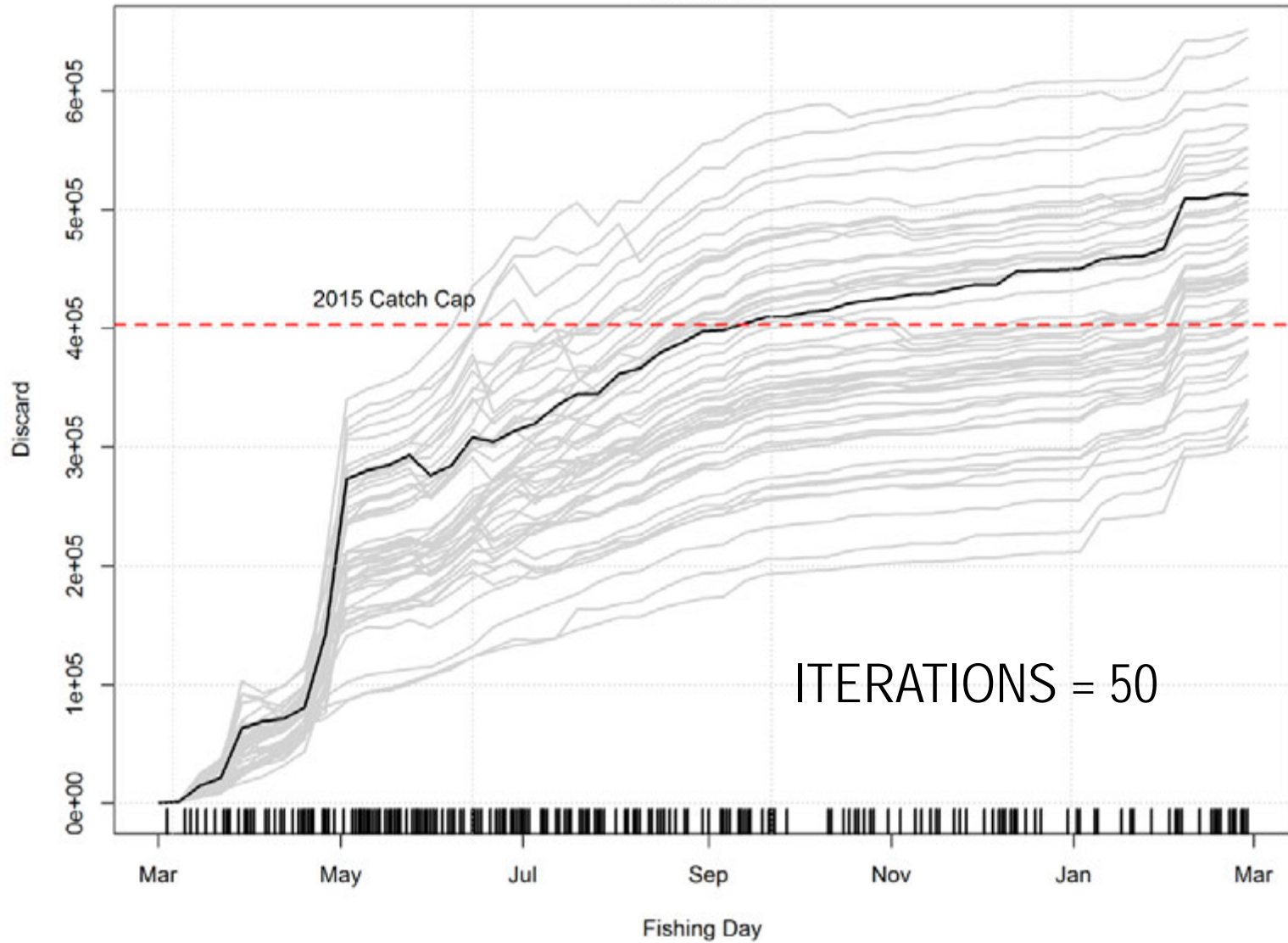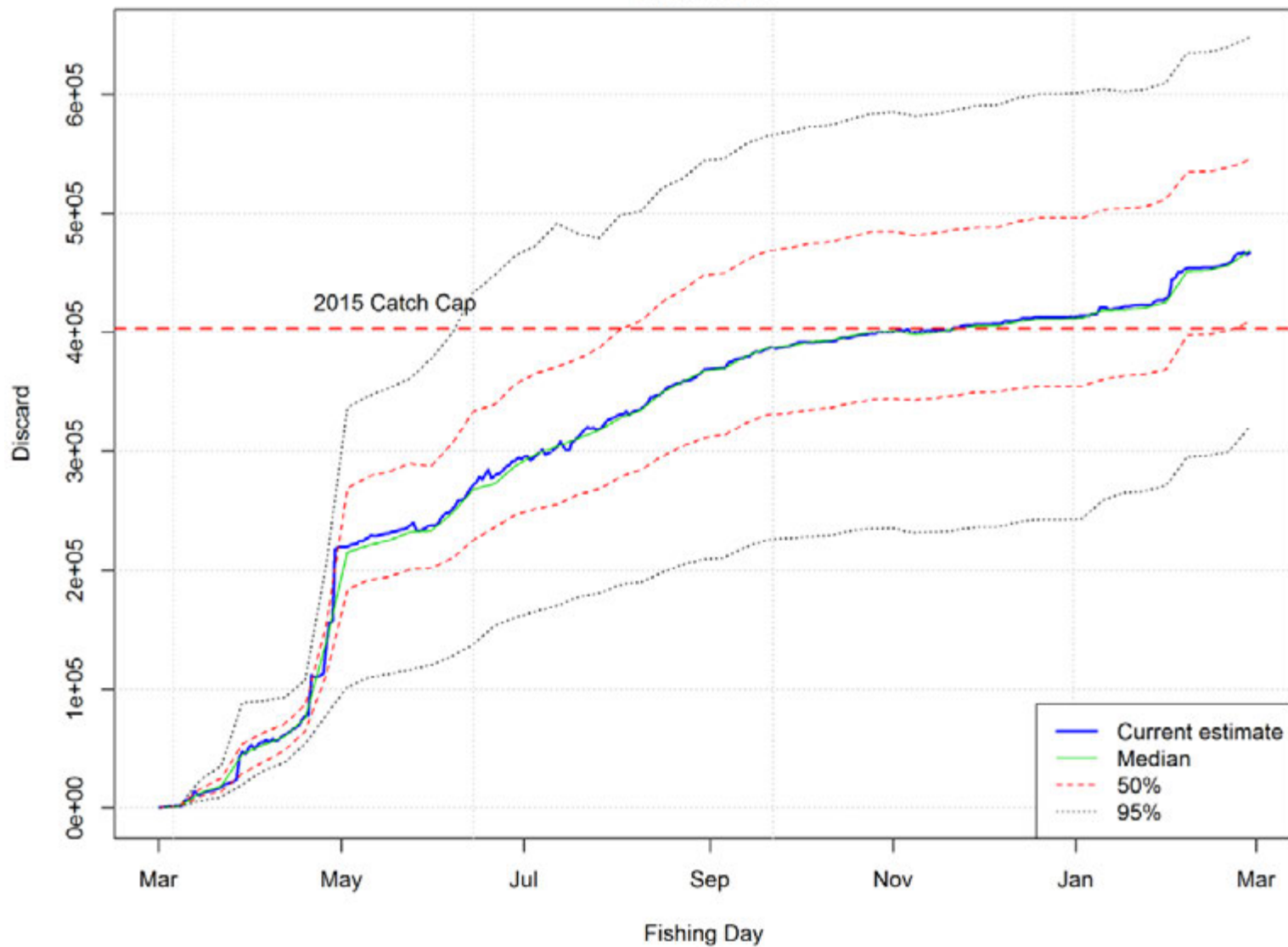 1. Default (n = 5)

  2. Moving window

year $t - 1$

year t

Fishing Day

Sampling simulations (bootstrap)

- Resample the observed trips
- Calculate discard rate and total discard
- Do this 1,000 times!

$i = 1$

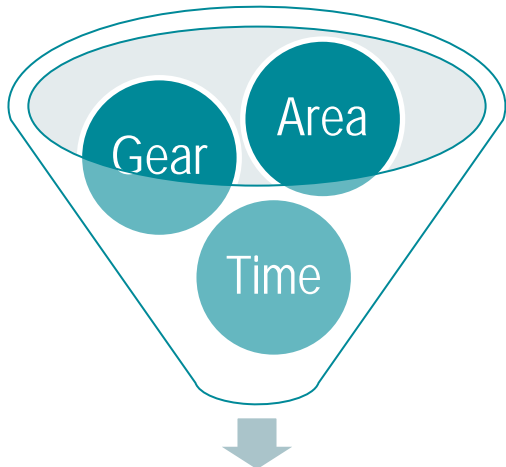Mar   May   Jul   Sep   Nov   Jan   Mar

$i = 2$

Mar   May   Jul   Sep   Nov   Jan   Mar

$\vdots$

$i = 1,000$

Mar   May   Jul   Sep   Nov   Jan   Mar

Fishing Day

SCAL_WP_SNE
FY 2015: 5 trip based Transition Rate
BASELINE

ITERATIONS = 50

SCAL_WP_SNE
FY 2015: 5 trip based Transition Rate
BASELINE

Analysis Framework

Reduce Data Dimensionality

Area + Vessel Category → Stratification Candidate → Resample observed trips

Evaluate Results
- CV performance
- Probability of premature closure

All Stratifications → All catch caps → All years → Transition rate → Resample observed trips
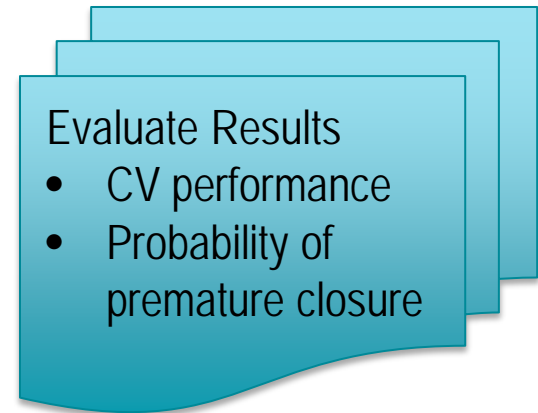
Image credit: Brant McAfee, GARFO

NOAA FISHERIES

Software tool

- Custom R package
- Current/future discard estimation
- Flexible and adaptable