NOAA FISHERIES

Assessing bycatch estimation methods under data-poor scenarios

NMFS Protected Species Toolbox
Mini-Symposium II
March 1-2, 2018

Presenter: K. Alexandra Curtis (OAI)

Motivation

- Many methods for bycatch estimation
  - Challenging and important problem
  - Diversity of challenges from sample size to meta-dataset
- But many challenges shared… common lessons on estimation method choice?
- Good estimates needed to underpin effective management and population assessments
  - Bias, error, and confidence interval coverage

Objectives

1. Develop guidance on when particular estimation methods may perform poorly

2. Inform managers and scientists wrt comparability of estimates from different methods

3. Assess mean and uncertainty prediction

Approach

- Large observer data sets as “whole truth” (varying fishery size, event frequency, data dispersion)
- Range of simulated observer coverages (5-50%, random and stratified design)
- For each simulation, estimate mean and confidence intervals at three coverage levels: 95%, 80%, 50%
- Evaluate

Approach: Estimation Methods

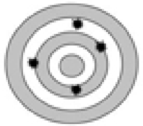
Estimation Method	NEFSC	SEFSC	SWFSC	NWFSC	AFSC	PIFSC
Mean-per-unit (binomial) (effort-based expansion)				✓*		
Wilson interval		✓				
bootstrap interval		✓	✓			
Ratio (landings-based expansion)						
analytical interval				✓	✓	
bootstrap interval	✓			✓		
BC bootstrap interval		✓				
BCa bootstrap interval	✓	✓				
Delta-lognormal		✓				
Horvitz-Thompson						✓
Generalized Linear Model						
Poisson	✓					
Binomial	✓					
Generalized Additive Model						
Poisson	✓					
Random Forest			✓			

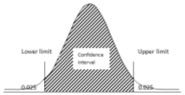
Approach: Estimation Methods

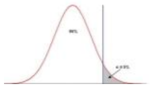
Estimation Method	NEFSC	SEFSC	SWFSC	NWFSC	AFSC	PIFSC
Mean-per-unit (binomial) (effort-based expansion)				✓*		
Wilson interval		✓				
bootstrap interval		✓	✓			
Ratio (landings-based expansion)						
analytical interval				✓	✓	
bootstrap interval	✓			✓		
BC bootstrap interval		✓				
BCa bootstrap interval	✓	✓				
Delta-lognormal		✓				
Horvitz-Thompson						✓
Generalized Linear Model						
Poisson	✓					
Binomial	✓					
Generalized Additive Model						
Poisson	✓					
Random Forest			✓			

Approach: Performance metrics

- Mean
  - Bias (ratio)
  - MAE (standardized)
  - RMSE (standardized)
- Confidence intervals:
  - Overall coverage
  - Upper tail error rate

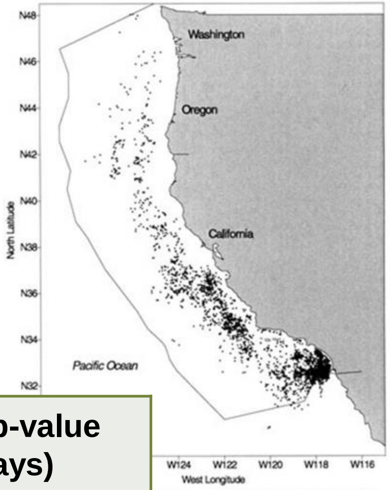






Approach: Data sets

- CDGN 1991-2000* (intra-annual estimates)
  - 71-134 observed trips yr^{-1}

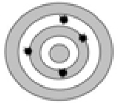


bserved sets in the California drift gillnet fishery for 996–2002.

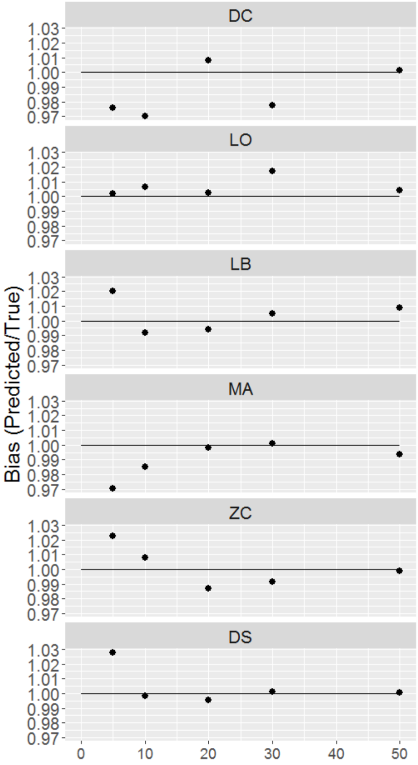
Species	Code	Catch (total)	Catch Yr^{-1} (range)	Var:Mean (annual)	Knox test p-value (20km, 3 days)
Leatherback turtle	DC	22	0 – 5	1.0	0.04
Pacific white-sided dolphin	LO	22	0 – 5	1.5	0.036
Northern right whale dolphin	LB	56	0 – 11	2.0	0.057
Elephant seal	MA	104	2 – 22	1.1	0.001
California sea lion	ZC	120	4 – 9	1.9	0.001
Short-beaked common dolphin	DS	301	9 – 45	1.6	0.001

* Approximates current fishery size but not management

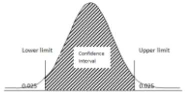
MPU: Mean Metrics



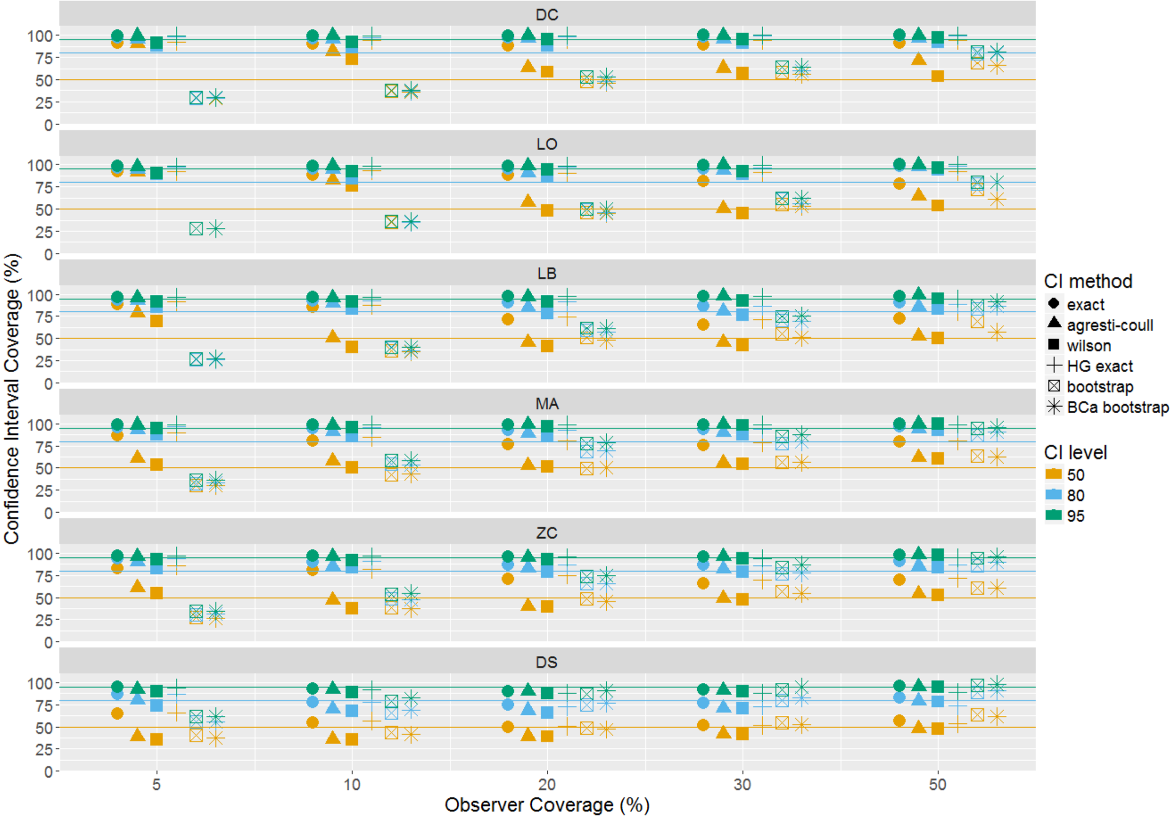
Code	Catch (total)	Var:Mean (annual)
DC	22	1.0
LO	22	1.5
LB	56	2.0
MA	104	1.1
ZC	120	1.9
DS	301	1.6



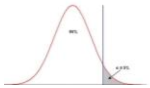
MPU: Confidence Interval Coverage



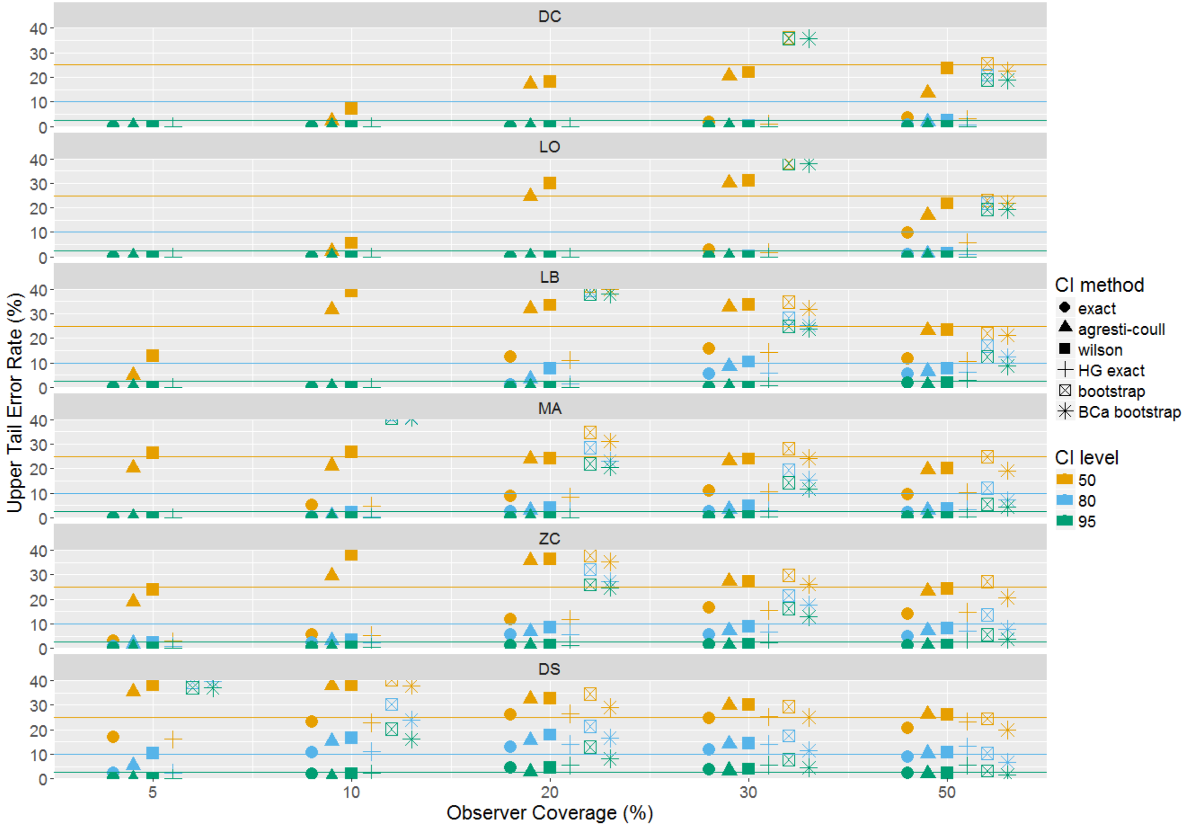
Code	Catch (total)	Var:Mean (annual)
DC	22	1.0
LO	22	1.5
LB	56	2.0
MA	104	1.1
ZC	120	1.9
DS	301	1.6



MPU: Upper Tail Error Rate



Code	Catch (total)	Var:Mean (annual)
DC	22	1.0
LO	22	1.5
LB	56	2.0
MA	104	1.1
ZC	120	1.9
DS	301	1.6



A Few Concluding Thoughts

- Filling in framework: more estimation and sampling methods, larger data sets
- MPU Confidence Intervals
  - Bootstrap intervals not compatible with small fishery (trip-level)
  - Wilson interval balances risk aversion and efficiency
    - Potential trouble areas: overdispersed data
    - Can handle years with zero observed catch
- Zeros: undetected species? Importance of fishery-independent risk assessment

Acknowledgments

This PDF was later amended to make the document 508 compliant.

Funding from NOAA Fisheries' Office of Science and Technology

Assistance and input from many individuals from every region and science center in NOAA Fisheries: Jim Carretta, Jeff Moore, Tina Fahy, Penny Ruvelas, Lauren Saez, Dan Lawson, Monica DeAngelis, Lyle Enriquez, Charles Villafana, Paul Richards, Lance Garrison, Melissa Soldevilla, Jennifer Lee, Jessica Powell, Nick Farmer, Michael Larkin, Stacey Horstman, Joshua Hatch, Kimberly Murray, Chris Orphanides, Marjorie Lyssikatos, Sean Hayes, David Gouveia, Carrie Upite, Ellen Keane, Kate Swails, Mark Minton, Michael Asaro, Edith Carson, Jason Jannot, Yong-Woo Lee, Thomas Good, Kayleigh Somers, Vanessa Tuttle, Jon McVeigh, Eric Ward, Susan Wang, Paul Wade, Suzie Teerlink, Bridget Mansfield, Aleria Jensen, Amanda Bradford, Donald Kobayashi, Summer Martin, Yonat Swimmer, Annie Yau, Irene Kelly, Dawn Golden

Feedback: alex.curtis@noaa.gov