Assessing Observer Coverage Performance for Rare Event Bycatch

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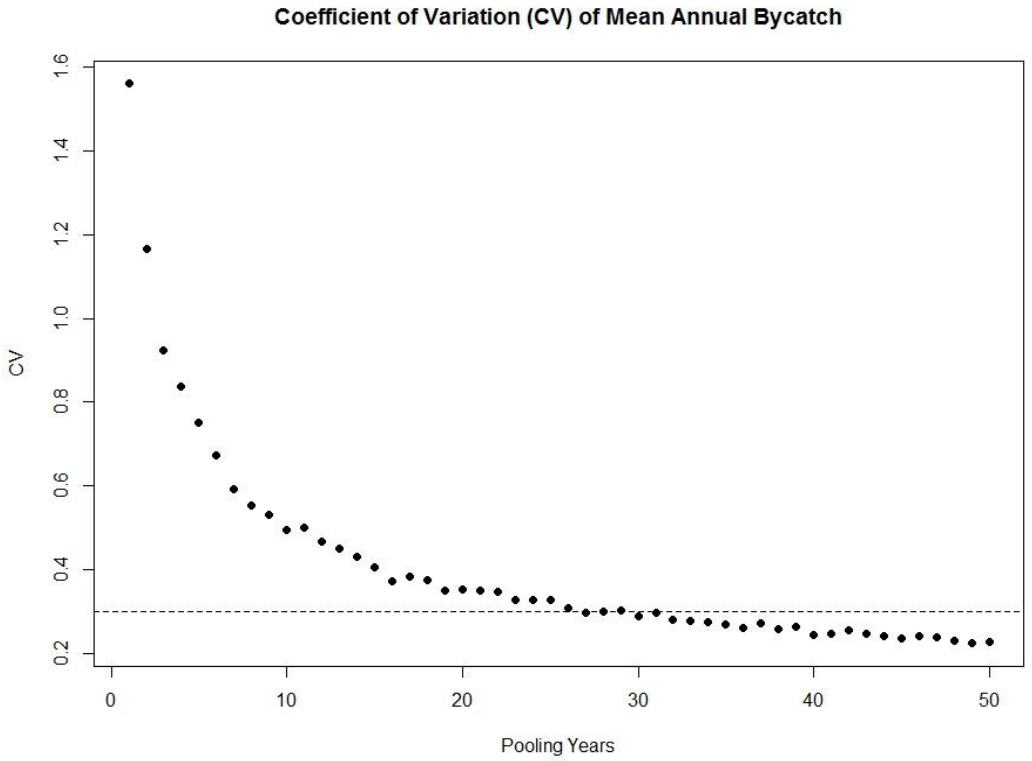
Introduction

- Analyst with SWFSC MMTD since 2010
  - Risk assessment
  - Population assessment
  - Tool development to support science-based management
- Background in fisheries oceanography
- AAAS S&T Policy Fellow

Rare event bycatch

- Often species of concern
- Challenging to estimate (Amandè et al., 2012; Carretta and Moore, 2014)
  - Bias
  - Imprecision
- Challenging to detect
  - need Ecological Risk Assessment

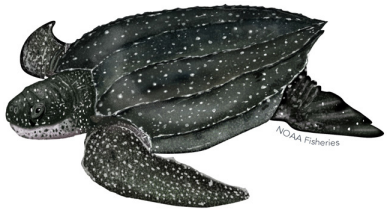


Carretta and Moore (2014), based on simulations with mean of two interactions per year in 1000 sets and 20% observer coverage

Sperm Whales in California Drift Gillnet Fishery

- 2010: two observed interactions
- Annual mean per unit estimate > Potential Biological Removal
- Triggered Take Reduction Team process
- Lessons
  - Multi-year estimates
  - Understanding probability of observing **any** bycatch

Why *ObsCovgTools*



- Automate repetitive tasks
- Stop reinventing wheel
- Interactive tool for scenario exploration
- Evaluate current coverage or guide future coverage
- Consideration of bycatch **composition**
- Bridge ERA and management

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ObsCovgTools: Assessing observer coverage needed to document and estimate rare event bycatch

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ARTICLE INFO

Handled by S Xavier Cadrin

Keywords:
Bycatch estimation
Fishery observer program
Limit reference point
Precision
Risk assessment
Software

ABSTRACT

Observer program design and evaluation often overlook the challenges of documenting rare-event bycatch. To support and facilitate consideration of threatened, endangered, and protected species bycatch in evaluating observer programs and assessing fisheries impacts, we developed a software tool to assess observer coverage with respect to several objectives for documenting or estimating rare-event bycatch. The *ObsCovgTools* package for the *R* programming language, also available as an online application, predicts observer coverage performance for a given total fishery effort in relation to three metrics: (1) the conditional probability of observing any bycatch given that bycatch occurred in the fishery and the probability of any bycatch in the total fishery effort, (2) the upper confidence limit for total bycatch when none is observed, and (3) precision (coefficient of variation) of the bycatch estimate. We describe the tool; explore how specific observer coverage targets for these metrics vary with total effort, BPUE, and dispersion index; and apply it to evaluate observer coverage in the California drift gillnet fishery. Our results underscore the importance of considering effort as well as percentage in assessing how well an observer program documents bycatch. We caution that rare species interactions may not be documented in many observer programs, and should be anticipated through a complementary risk assessment approach. The tool's modular design and open source programming approach encourage adaptation and augmentation to address additional objectives or complexities in sampling design or estimation.

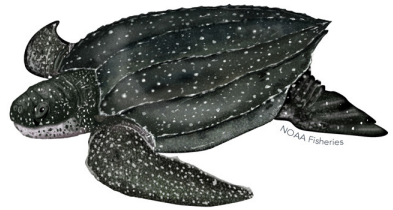
ObsCovgTools

What is *ObsCovgTools*?

- A user-friendly simulation tool for assessing observer coverage in terms of documenting and estimating rare-event bycatch

Metrics

- **Bycatch composition**
  - Probability of positive bycatch in observed (total) effort (PPOS)
  - Upper confidence limit of bycatch given none observed (UCL)
- **Bycatch estimation**
  - Expected precision of bycatch estimates (CV)



Use notes

Required input

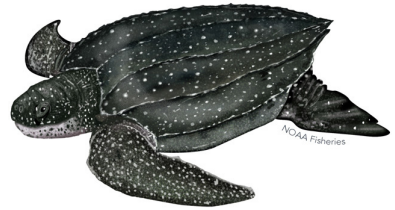
- Total effort, dispersion index (UCL)
- + Bycatch rate (PPOS, CV)

Optional input

- Performance benchmark (e.g., desire 30% CV)

Assumptions

- Observer coverage is representative
- No higher-level sources of variance (e.g., vessel)



Probability of positive bycatch

Observer coverage simulator - 3.1.1

Objective: Probability of Positive Bycatch | Objective: Upper Confidence Limit Given No Bycatch Observed | Objective: Bycatch Estimation CV | About

Total effort in fishery (e.g., trips)

400

Bycatch per Unit Effort (BPUE)

0.005

Dispersion index for BPUE

(Dispersion index d is variance:mean ratio of BPUE, with more skewed data having higher d. d=2 is a relatively conservative default for rare event bycatch of marine mammals and turtles. Seabirds and fishes tend to be more skewed.)

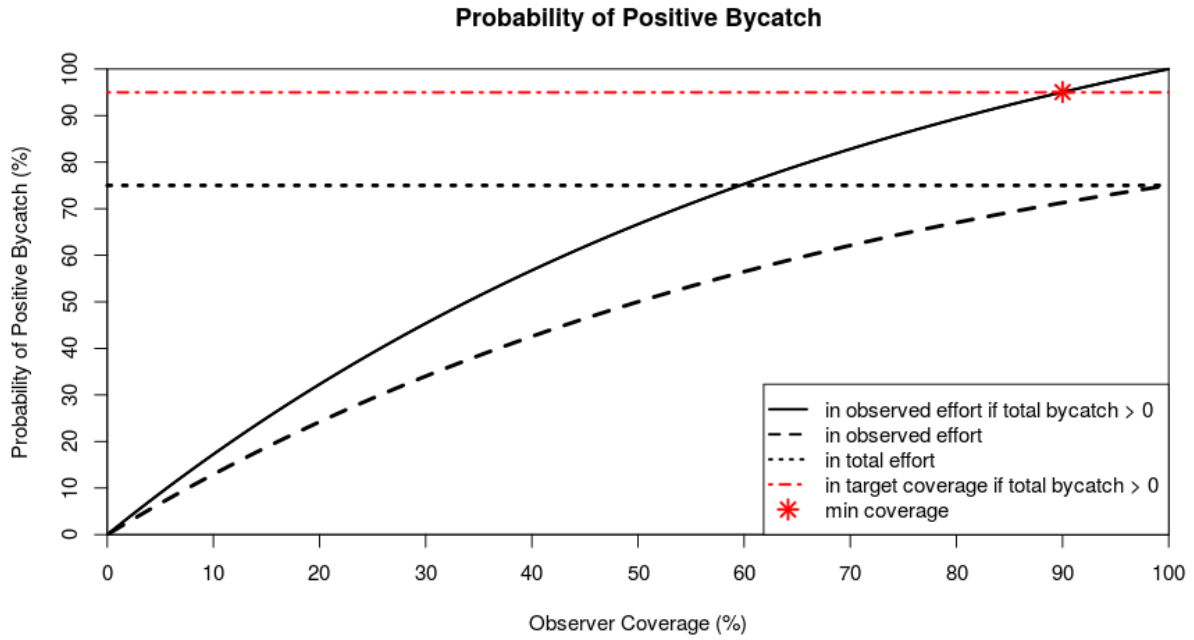
2

Target probability of observing bycatch

(Given positive bycatch in total effort. Set to zero to omit.)

0 95

0 10 20 30 40 50 60 70 80 90 100



The probability that any bycatch occurs in the given total effort (horizontal black dotted line) is 75%. Minimum observer coverage to achieve at least 95% probability of observing bycatch when total bycatch is positive is 90% (360 trips or sets). The conditional probability of observing any bycatch if it occurs (solid black line) is obtained by dividing the absolute probability of observing any bycatch (black dashed line) by the probability that any bycatch occurs in the given total effort. Please review the caveats in the About tab.

Upper Confidence Limit with zero observed

Observer coverage simulator - 3.1.1

Objective: Probability of Positive Bycatch | Objective: Upper Confidence Limit Given No Bycatch Observed | Objective: Bycatch Estimation CV | About

Total effort in fishery (e.g., trips)

400

Dispersion index for BPUE

(Dispersion index d is variance:mean ratio of BPUE, with more skewed data having higher d. d=2 is a relatively conservative default for rare event bycatch of marine mammals and turtles. Seabirds and fishes tend to be more skewed.)

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Confidence level for upper confidence limit (UCL)

50 95 100

50 55 60 65 70 75 80 85 90 95 100

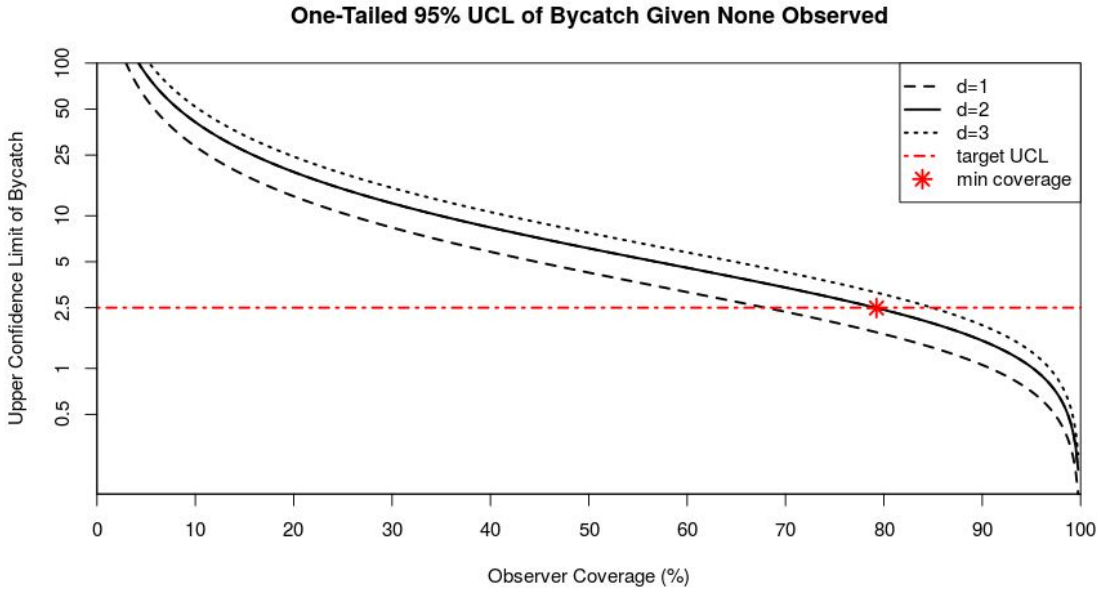
Target maximum UCL given zero bycatch observed

(Set to zero to omit.)

2.5

Percent observer coverage for which to return UCL

20



Minimum observer coverage to ensure that the upper confidence limit of 2.5 is not exceeded when no bycatch is observed is 79.3% (317 trips or sets). Upper confidence limit for bycatch given none observed in 20% (80 trips or sets) coverage is 19.4. Please review the caveats in the About tab.

Bycatch estimation precision

Observer coverage simulator - 3.1.1

Objective: Probability of Positive Bycatch | Objective: Upper Confidence Limit Given No Bycatch Observed | Objective: Bycatch Estimation CV | About

Total effort in fishery (e.g., trips)
(Larger effort takes longer: ~20s for 10K, ~75s for 100K)

400

Bycatch per Unit Effort (BPUE)

0.005

Dispersion index for BPUE
(Dispersion index d is variance:mean ratio of BPUE, with more skewed data having higher d. d=2 is a relatively conservative default for rare event bycatch of marine mammals and turtles. Seabirds and fishes tend to be more skewed.)

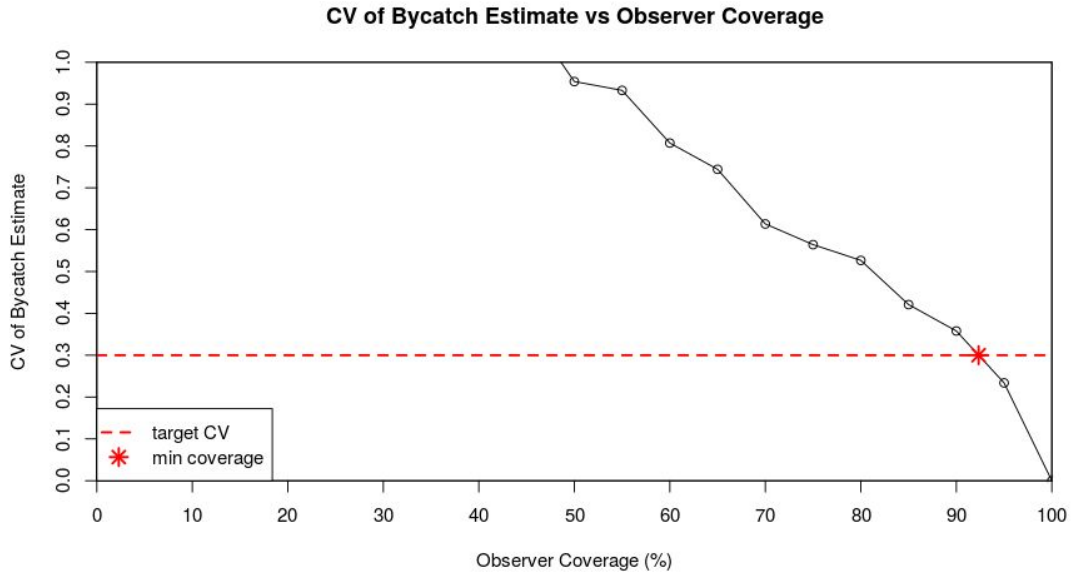
2

Submit

Target CV for bycatch estimates
(Set to zero to omit.)

0 0.3 0.99

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 0.99



Minimum observer coverage to achieve CV <= 0.3 is 93% (370 trips or sets). Results are interpolated from simulation-based projections and may vary slightly with repetition. Please review the caveats in the About tab.

Looking across species

Based on California Drift Gillnet Fishery, 2002–2016

Species	Total bycatch	BPUE	d	LRP	1 year % (n)	5 years % (n)	10 years % (n)
Loggerhead Sea Turtle (*Caretta caretta*)	1	0.002	1	–	95 (76)	92 (369)	88 (700)
Minke Whale (*Balaenoptera acutorostrata*)	1	0.002	1	3.5	95 (76)	92 (369)	88 (700)
Bottlenose Dolphin (*Tursiops truncates*)	1	0.002	1	11	95 (76)	92 (369)	88 (700)
Humpback Whale (*Megaptera novaeangliae*)	1	0.002	1	16.7	95 (76)	92 (369)	88 (700)
Dall's Porpoise (*Phocoenoides dalli*)	1	0.002	1	172	95 (76)	92 (369)	88 (700)
Leatherback Sea Turtle (*Dermochelys coriacea*)	2	0.005	1	0.16	95 (76)	88 (350)	72 (572)
Gray Whale (*Eschrichtius robustus*)	2	0.005	1	801	95 (76)	88 (350)	72 (572)
Sperm Whale (*Physeter macrocephalus*)	2	0.005	2	2.5	95 (76)	91 (363)	82 (658)
Short-Finned Pilot Whale (*Globicephala macrorhynchus*)	3	0.007	1	4.5	94 (75)	81 (322)	54 (430)
Northern Elephant Seal (*Mirounga angustirostris*)	5	0.011	1	4882	92 (74)	62 (250)	33 (265)
Risso's Dolphin (*Grampus griseus*)	6	0.014	3	46	94 (75)	78 (312)	49 (395)
Pacific White-Sided Dolphin (*Lagenorhynchus obliquidens*)	9	0.02	2.1	191	92 (74)	53 (213)	27 (219)
Long-Beaked Common Dolphin (*Delphinus capensis*)	12	0.027	1.5	657	89 (71)	34 (135)	17 (135)
Northern Right Whale Dolphin (*Lissodelphis borealis*)	17	0.038	1.6	179	84 (67)	25 (98.1)	12 (98.1)
Northern Fulmar (*Fulmarus glacialis*)	20	0.045	3.5	–	88 (70)	33 (132)	16 (132)
California Sea Lion (*Zalophus californianus*)	92	0.208	4	14011	40 (32)	8 (32)	4 (32)
Short-Beaked Common Dolphin (*Delphinus delphis*)	94	0.213	1.4	8393	21 (17)	4 (17)	2 (17)

Curtis and Carretta (2020)

ObsCovgTools

- Facilitates assessment of observer coverage in a fishery, with respect to rare-event bycatch **composition** and **estimation**
- Can bridge ERA and management
- Can inform observer program design

Antigua Convention Article IV, paragraph 2:

In particular, the members of the Commission shall be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures.

Web application:
https://kacurtis.shinyapps.io/obscov/

Github site:
https://github.com/kacurtis/ObsCovgTools

Journal article:
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