Participating in Today's Webinar

Ground Rules for Speaking:
- Be respectful and direct comments at the presenters.
- When you are called on, we will un-mute you, and then you will need to un-mute yourself.
- <u>Today's event is being recorded</u> (including anything typed into the questions box) and will be available through the event registration page after the meeting.

### *How to Participate Tonight:*
- <u>TEAM MEMBERS:</u>
  - We will have several times set aside for brief clarifying questions.
  - Type QUESTION in the questions box to get in line. Please include the presenter your question is for and slide number or topic of your question.
- <u>PUBLIC:</u>
  - There is time set aside at the end for members of the public to comment.
  - Type COMMENT in the 'questions box' to get in line.
  - If you know you will be making public comment at the end, please let us know as soon as possible. The amount of time per public comment will be 2 min.
- For questions or public comment, you may change your mind at any time. Say or type pass when your name is called.

Informational Webinar: Update on Right Whale Population and Mortality Estimates

Atlantic Large Whale Take Reduction Team Webinar

November 2, 2021

Marisa Trego
Kara Shervanick
Jen Goebel
Crystal Franco
Chao Zou
Colleen Coogan
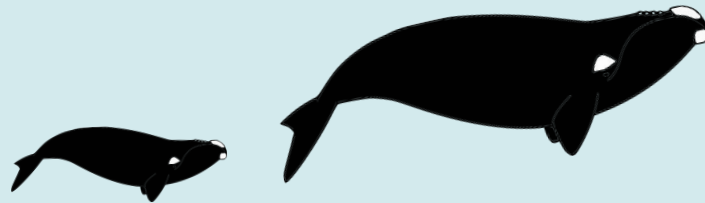
Atlantic Large Whale Take Reduction Plan Website

What to Expect

Scope:

- Update on right whale population and mortality estimates and risk reduction target

Agenda:

- 4:00 - 4:00 pm: Introduction
- 4:05 - 4:20 pm: Population update from Dr. Danielle Cholewiak
- 4:20 - 4:35 pm: Population model presentation from Dr. Daniel Linden
    - 4:35 - 4:50 pm: Brief clarifying questions for Dr. Cholewiak and Dr. Linden

- 4:50 - 5:00 pm: Atlantic Scientific Review Group Recommendations presented by Dr. Richard Merrick
    - 5:00 - 5:10 pm: Brief clarifying questions for Dr. Merrick

- 5:10 - 5:30 pm: Risk Reduction Target presented by Colleen Coogan
    - 5:30 - 5:50 pm: Brief clarifying questions for GARFO

- 5:50-5:55
    - Next steps
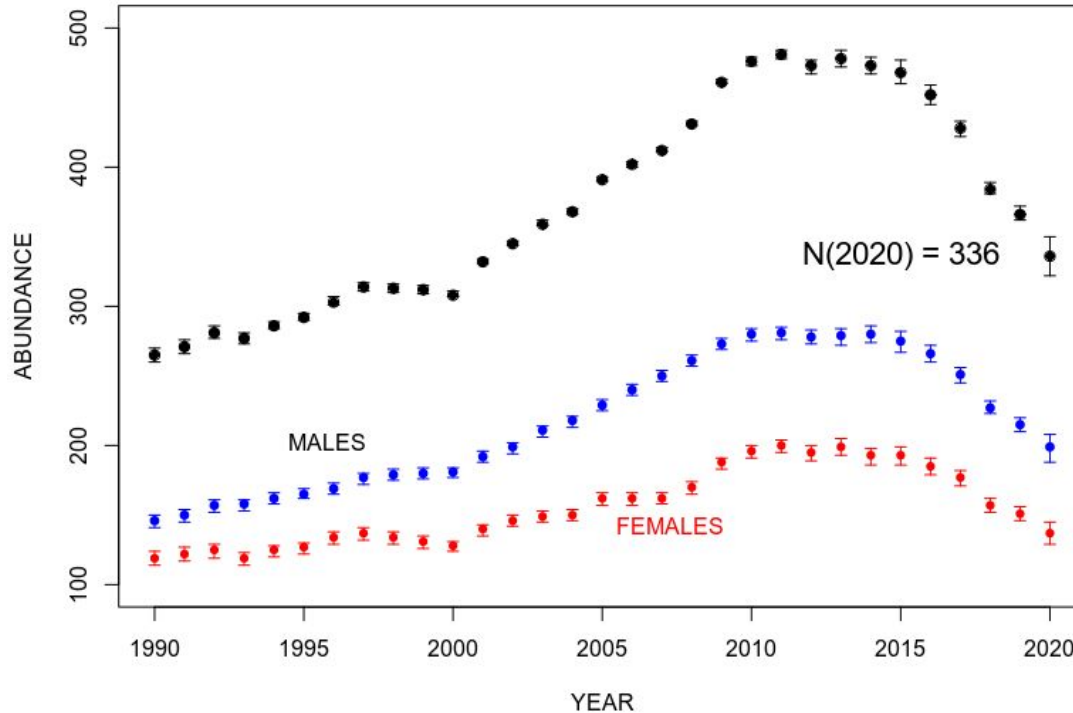
- 5:55 - 6:00 pm: Public Comment

NOAA Northeast Fisheries Science Center
Large whale status update

NOAA Northeast Fisheries Science Center
Atlantic Large Whale Take Reduction Team Informational Webinar
November 2, 2021

Right whale population estimate update

As of the beginning of 2020
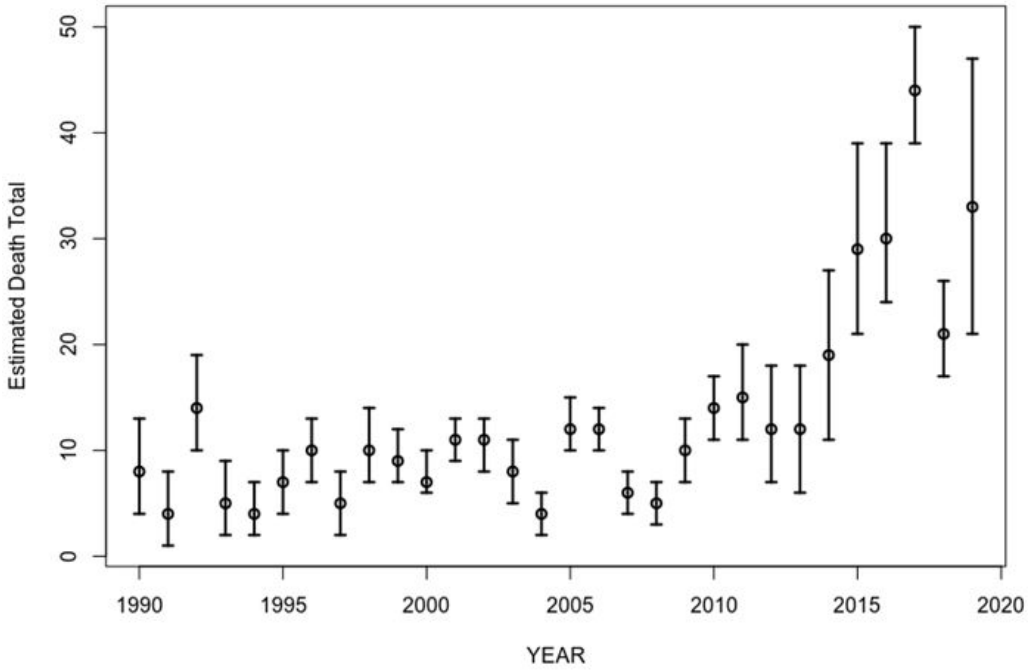

LCL=321
Median = 337
UCL=350

N(2020) = 336

Females:
LCL=128
Median=137
UCL=145

Estimated Annual Mortality

YEAR	EST Mort (median)	Obs Mort	Obs SI	Obs SI+M
2015	29	3	4	7
2016	30	4	9	13
2017	44	17	2	19
2018	21	3	6	9
2019	33	10	2	12

Mortality Rate
(adjusted for population size)
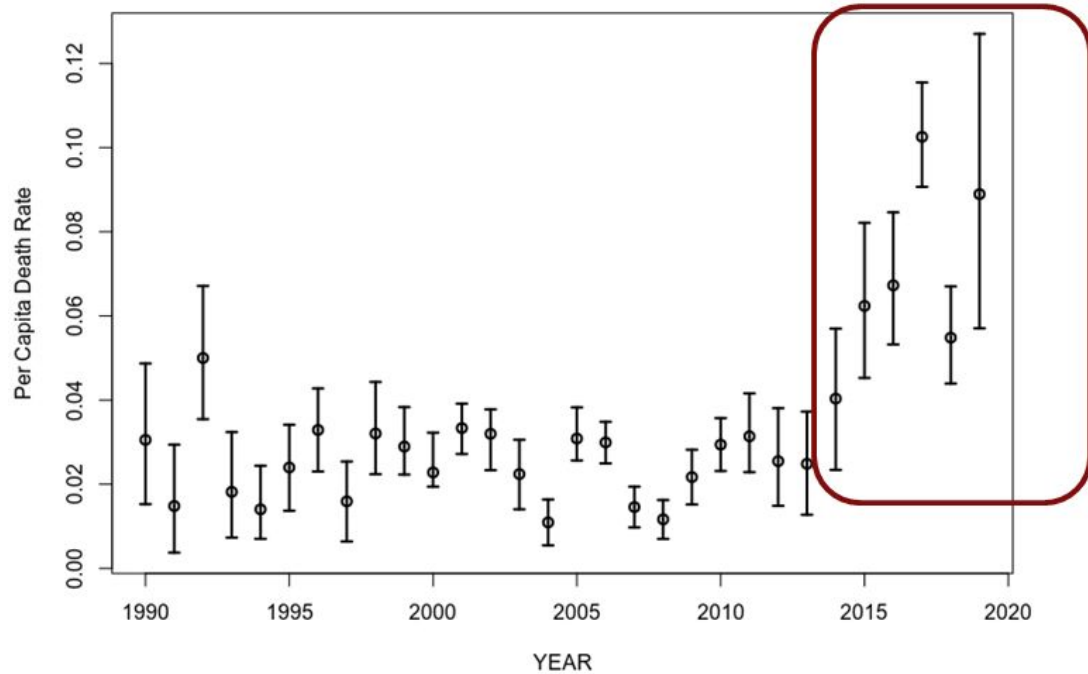
Female Reproduction

- Known reproductive females: ~68 with 50% or greater probability of being alive
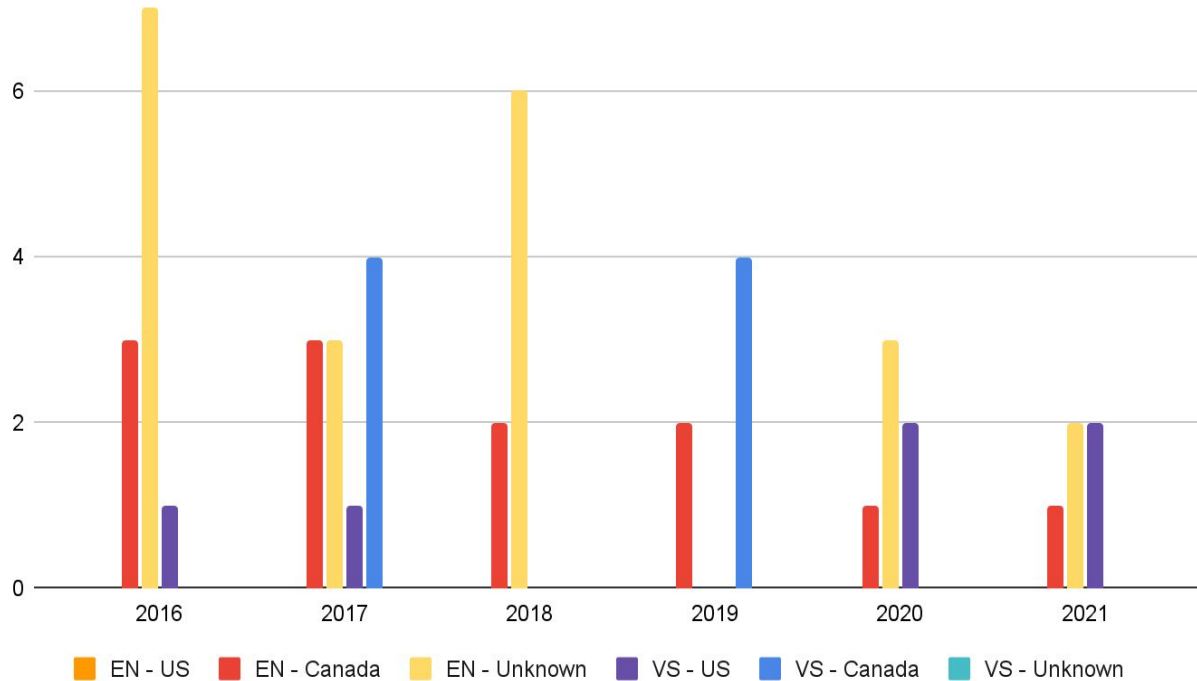
- Recent reproductive history
  - 2011-2020
  - 96 females gave birth to 113 calves
  - 37 of these females not recaptured since 2018
  - At least 8 known dead

Right whale serious injury updates

2016-2021 Observed Right Whale M/SI events by Cause & Country

Chart legend: EN - US, EN - Canada, EN - Unknown, VS - US, VS - Canada, VS - Unknown

2016-2020 Observed M/SI*

	Entangled	Vessel	UNK	TOT
UNK	19	0	6	25
US	0	4	0	4
CN	11	8	11	19
TOT	30	12	17	59

* not incl 2020 neonate

Understanding causes of mortality is a challenge

- Most mortalities are unobserved

    → cryptic NARW deaths ~2/3 total (Pace *et al.* 2021)

- Even observed mortalities can be ambiguous

Injuries might indicate future mortality events

- Entanglements reduce body condition & survival
  - → e.g,. Schick *et al.* (2013), Pettis *et al.* (2017)

- Serious injuries lead to "disappearance" (Pace *et al.* 2021)

- More information from sightings than carcasses

Multi–state mark–recapture–recovery (MSMRR): states

parameters:
φ = Pr(survival)
m = Pr(mortality)
φ = 1−m
i = Pr(sev injury)
ψ = Pr(injury retention)

causes:
E = entanglement
V = vessel strike
O = other

$$\phi_{[E]}\psi$$

injured [E]

$$m_{[E]}$$

dead [E]

$$i_{[E]}m_{[E]}$$

$$\phi_{[E]}(1-\psi)$$

$$i_{[E]}\phi_{[E]}$$

alive

$$(1-i_{[V]}-i_{[E]})m_{[O]}$$

dead [O]

DEAD

$$\phi_{[O]}(1-i_{[V]}-i_{[E]})$$

$$\phi_{[V]}$$

$$i_{[V]}\phi_{[V]}$$

$$i_{[V]}m_{[V]}$$

injured [V]

$$m_{[V]}$$

dead [V]
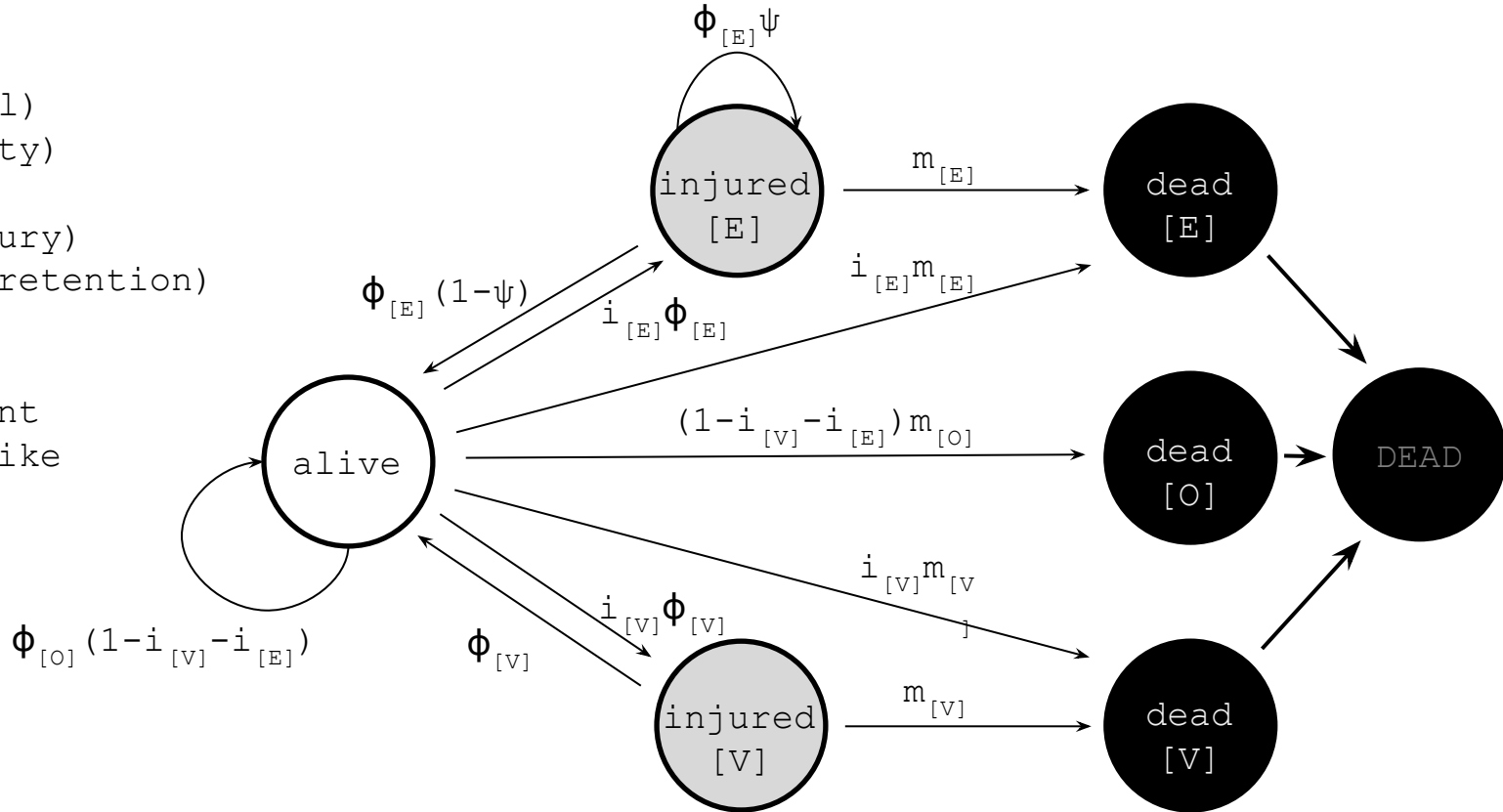
Multi–state mark–recapture–recovery (MSMRR): observations

parameters:
```
p = Pr(sighting)
r = Pr(recovery)
ic = Pr(inj cause)
mc = Pr(mort cause)
```

causes:
```
E = entanglement
V = vessel strike
O = other
```

states

	alive	injured [E]	injured [V]	dead [E]	dead [V]	dead [O]
1	p	0	0	0	0	0
2	0	$p(ic)$	0	0	0	0
3	0	0	0	$r_{[E]}mc$	0	0
4	0	0	$p(ic)$	0	0	0
5	0	0	0	0	$r_{[V]}mc$	0
6	0	$p(1-ic)$	$p(1-ic)$	0	0	0
7	0	0	0	$r_{[E]}(1-mc)$	$r_{[V]}(1-mc)$	$r_{[O]}$
8	$1-p$	$1-p$	$1-p$	$1-r_{[E]}$	$1-r_{[V]}$	$1-r_{[O]}$

observations

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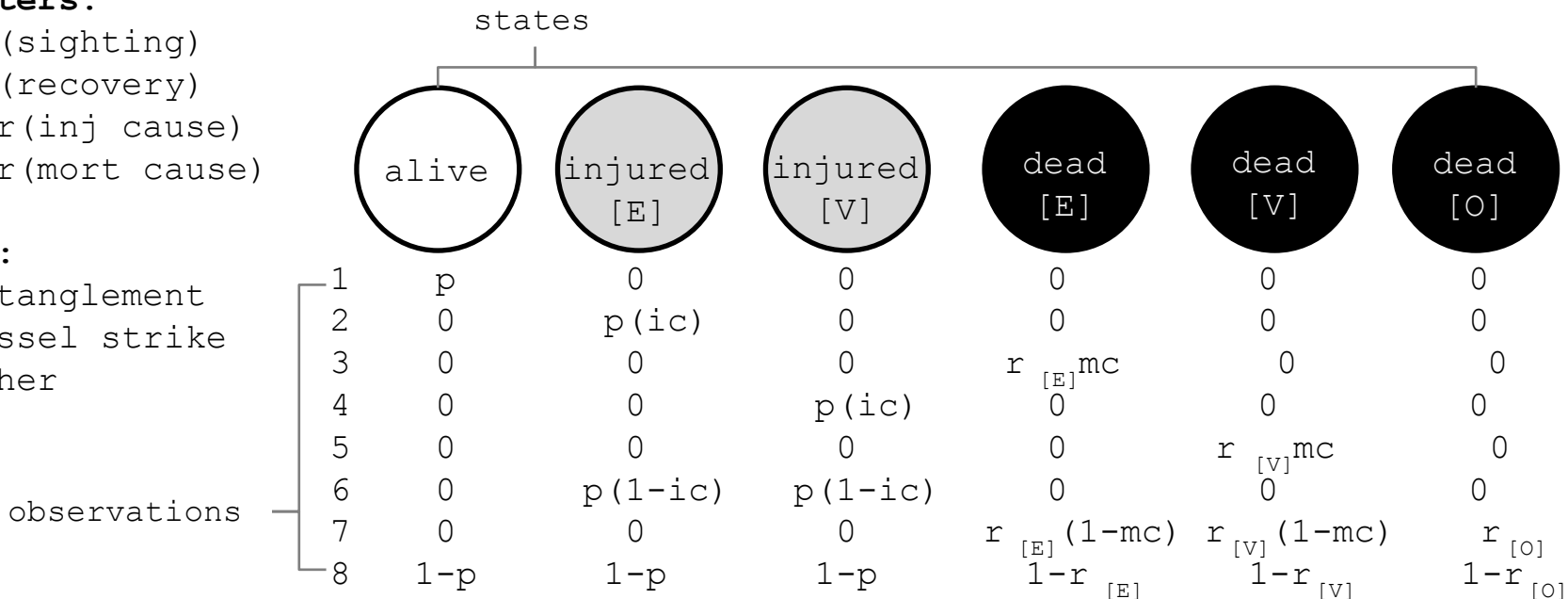
Multi–state mark–recapture–recovery (MSMRR)

- Combination of sightings data and identified carcass recoveries
    - → severe injuries/mortalities with known and unknown causes
    - → NEAq classification of "severe"
    - → 1990–2019

- 7 true states; 8 observed states
    - → "unknown" severe injury either entanglement or vessel strike

- Mortality conditional on severe injury (or lack thereof)
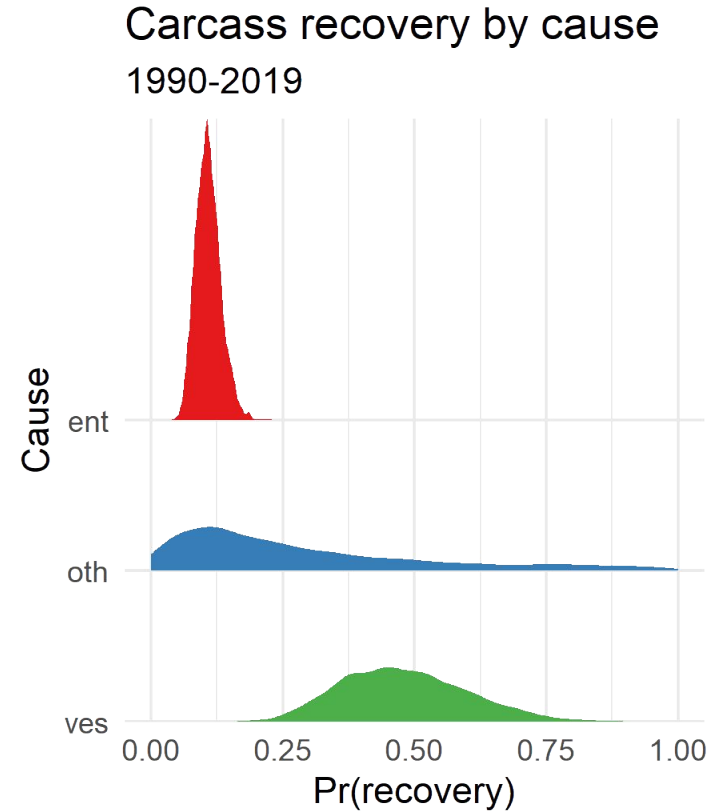
Multi-state mark-recapture-recovery (MSMRR)

- Fixed effects
  - → Decade
  - → Regime (pre/post 2012)
  - → **Recent calf**

- Random effects:
  - → Time (p, rates of injury/mortality)
  - → Individual (p)

- Some assumptions
  - → No age effects
  - → Other mortality forced to be "low"
  - → Carcass recovery constant across time
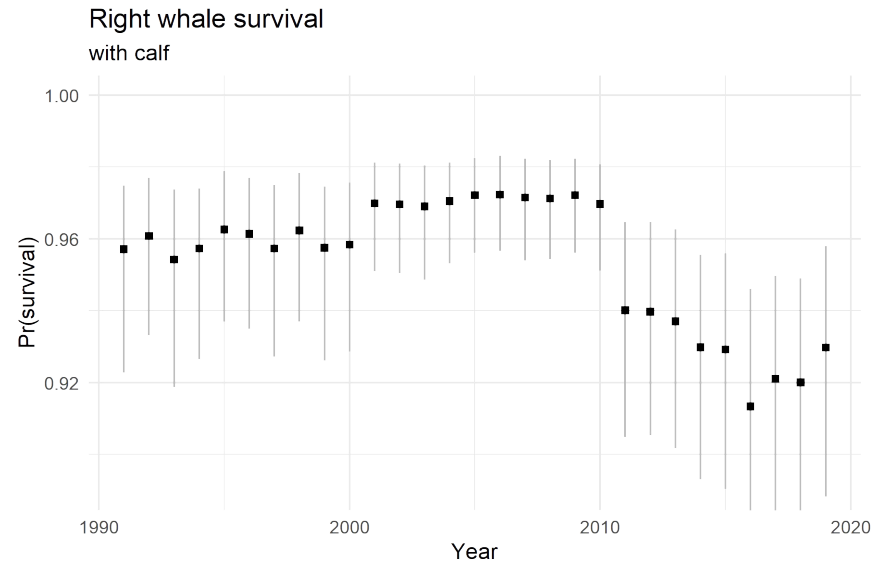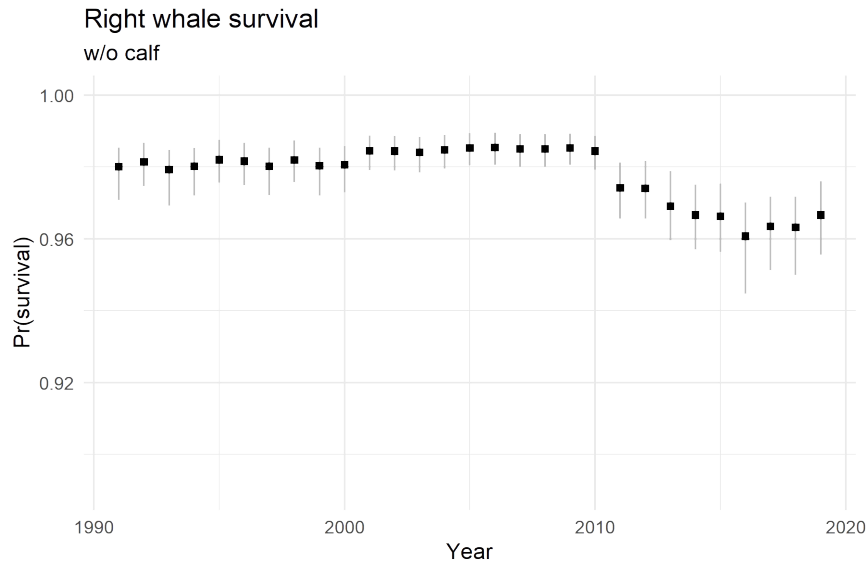 - → $mc_{[E]} = mc_{[V]}, \ ic_{[E]} = ic_{[V]}$

NIMBLE

Preliminary results

- Large discrepancy between recovery of entanglement vs. vessel strike deaths
- Huge uncertainty for "other"

Carcass recovery by cause
1990-2019

Preliminary results

Right whale survival
w/o calf

Right whale survival
with calf

Preliminary results

Right whale mortality
w/o calf

Right whale mortality
with calf
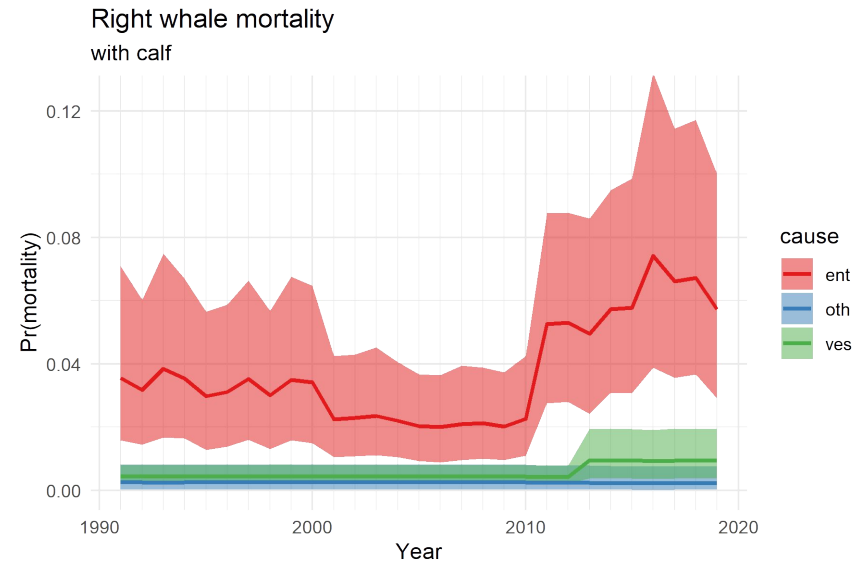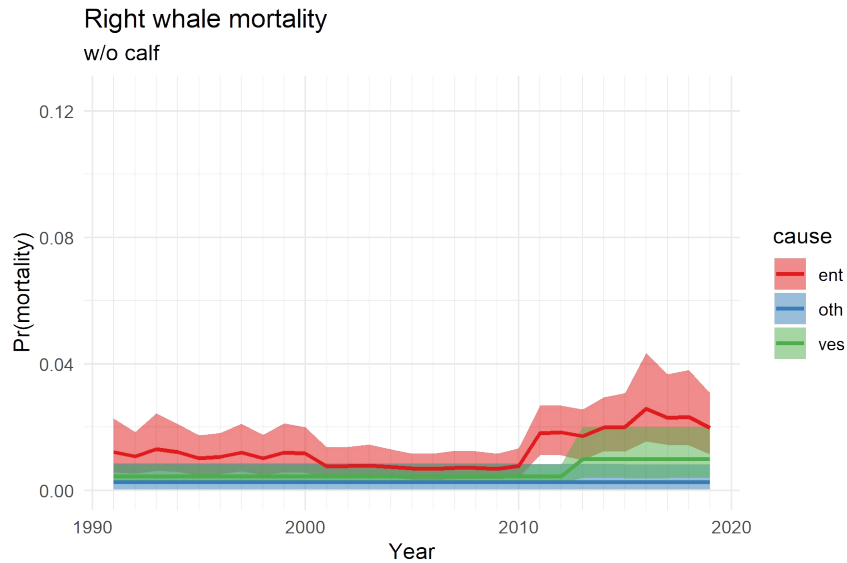
▪ Females that were recently with a calf had significantly higher rates of severe entanglement injury

Preliminary results

NARW mortality cause (2010-2019)
w/o calf

NARW mortality cause (2010-2019)
with calf
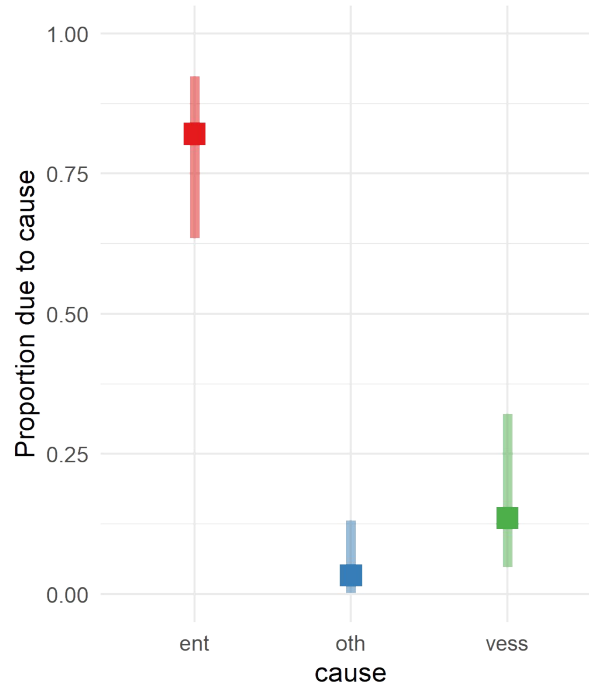
NARW mortality cause (2010-2019)
population wide

```
Ent 0.641 [0.385, 0.835]
Oth 0.080 [0.005, 0.311]
Ves 0.251 [0.096, 0.518]
```

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Preliminary results

- Low survival given severe injury
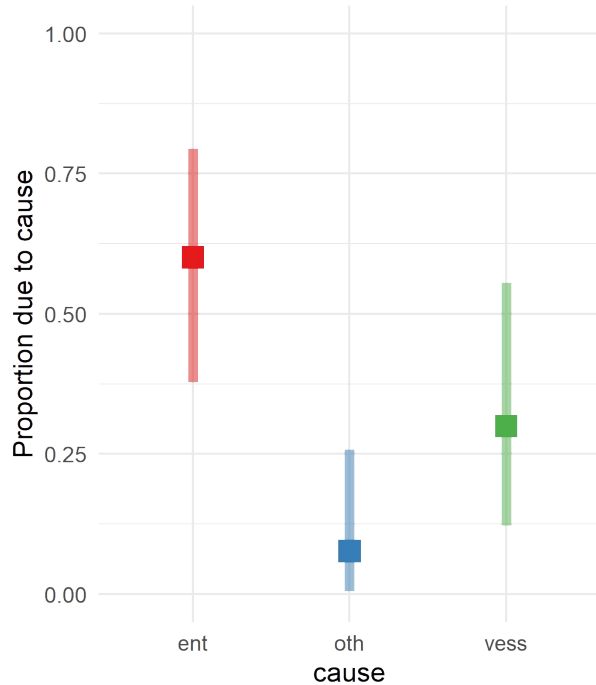 - → 33% (vessel strike) vs. 37% (entanglement)

- Females w/ calves higher total mortality due to entanglement
  - → increased rate of severe ent injury
  - → similar rate of mortality, given injury

- Higher total mortality in last decade
  - → increased rate of severe injury due to entanglement
  - → increased rate of mortality given severe injury due to vessel strike

Caveats/concerns

- Variable rates of injury detection?
    - → hazards occur in continuous time
    - → model uses discrete time observations

- Low natural mortality induced by informed prior
    - → somewhat artificial
    - → could/should be none?

- Model complexity

Acknowledgements

- This work is only possible due to the contributions of many Consortium members who have shared individual whale sightings data made useful through continuously meticulous curatorial action of the folks at New England Aquarium.

- Population Evaluation Team (PET) subgroup
  - Richard Pace (*chair*), Diane Borggaard, Lance Garrison, Dan Linden (NMFS)
  - Mike Runge (USGS)
  - Véronique Lesage (DFO)
  - Jeff Hostetler (USFWS)
  - Amy Knowlton (NEAq)
  - Rob Williams (Oceans Initiative)

Questions
Use the 'Questions' box to get in line

ASRG ADVICE TO NMFS ON RIGHT WHALE STOCK ASSESSMENT ISSUES

Report to the ALWTRT

2 November 2021

BACKGROUND

- The Atlantic Scientific Review Group (ASRG) is the MMPA designated peer review body for Atlantic and Gulf of Mexico marine mammal stock assessments

- ASRG asked by NMFS to provide advice on six questions related to the analysis and reporting of large whale Serious Injuries and Mortalities for the 2022 Marine Mammal Stock Assessment Report

- This is a summary of the responses to NMFS

QUESTION 1:
SHOULD ALL NARW MORTALITY BE CONSIDERED ANTHROPOGENIC?

- ASRG recommends that:

  - Based on the history of observed non calf mortalities

  - 100% of non calf mortalities should be considered to be of anthropogenic origins.

- This does not preclude inclusion of a term for "other mortalities" in NMFS' *Multi-Stage Mark Resight and Recapture* (MSMRR) model to deal with calf mortalities.

QUESTION 2:
HOW SHOULD MORTALITY BE APPORTIONED BY **CAUSE?**

- The ASRG recommends that:

    - The <u>ratio</u> between Entangled (EN) and Vessel Struck (VS) North Atlantic right whales (NARW)

    - Calculated from <u>documented observations</u> of Serious Injuries and Mortalities (SIM)

    - Over the <u>most recent five years,</u>

- Should be used to apportion cause.

QUESTION 3:
HOW SHOULD MORTALITY BE APPORTIONED BY **COUNTRY?**

☐ NMFS listed several approaches to apportioning Mortality between US and Canada

☐ However, robust scientific advice requires much more information on the location of initial NARW entanglement

☐ As such, we cannot provide scientific advice to address this question.

QUESTION 4:
APPORTION TOTAL MORTALITY
OR JUST UNSEEN CASES?

- The ASRG recommends apportioning the <u>total mortality estimate</u> produced by NMFS' *Mark Resight and Recapture* (MRR) model

QUESTION 5:
WHAT ARE THE APPROPRIATE TIME FRAMES FOR REPORTING?

- The total mortality and abundance estimates for NARW produced by the MRR model are aligned.

- However, there is always one more year of SIM observations that are not included in the MRR mortality and abundance estimates.

- ASRG recommends this protocol be retained

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6
Mortality						
Abundance						
Observed SIM						

QUESTION 6:
WHAT TIME PERIODS ARE APPROPRIATE FOR REPORTING IN 2022 SAR?

- Total mortality estimate —1 January 2015 through 31 December 2019

- Abundance estimate —1 January 2020

- Apportionment of Mortalities between EN and VS —use the ratio of observed SIM for 1 January 2016 through 31 December 2020

QUESTIONS?
Use the 'Questions' box to get in line

North Atlantic Right Whale
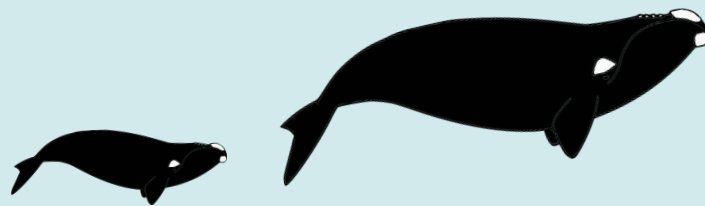
History of the Target

Tim Cole (NEFSC)takes tissue samples from a decomposed Atlantic right whale (#4505) adrift off Chappaquiddick. — U.S. Coast Guard under NMFS Permit #18786-02

	PBR	Lower bound	Upper bound
Apr 2019	0.9	Observed only	Including estimated mortalities
Nov 2021	0.7	NONE	Only estimated mortalities

ASRG Recommendations

Apportionment by cause:
- Assume all non-calf mortality is entanglement or vessel caused
- The ratio between entangled and vessel struck NARW
  - Calculated from documented observations of Mortalities and Serious Injuries
  - Over the last five years
- Use that ratio to apportion the total mortality estimate produced by the Pace MRR model.

Advice on time periods (as recommended for 2022 SAR):
- Apportionment of M/SI by cause (EN or VS), use ratio from the most recent five years
  - Observed M/SI for 2016-2020
- Apply across most recent total mortality estimate — 2015-2019

Apportionment by country:
- No recommendation because of lack of information on entanglement incident initial locations.

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Apportionment by Cause: 2016 - 2020
Ratio between entangled and vessel struck NARW

Calculate ratio from documented observations of Mortalities and Serious Injuries over the last five years - 2016-2020 specifically recommended by ASRG

Year	Known M/SI *Total*	Known M/SI *Entanglement*	Known M/SI *Vessel Strike*	Source
2016	10.5	9.5	1	2020 SAR
2017	11	6	5	2020 SAR
2018	7.25	7.25	0	2020 SAR
2019	6	2	4	2021 draft SAR
2020*	5.75	3.75	2	UME page - preliminary data
2016-2020	**40.5**	**28.5**	12	

$$\frac{28.5 \text{ EN}}{40.5 \text{ TOT}} = 70\% \text{ EN}$$

*Cottontail (#3920) is included in 2020 data as that is when he was first sighted with the entanglement. The UME page lists him as a 2021 mortality.

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Use total estimated mortality 2015-2019

Use the observed M/SI ratio to apportion the total mortality estimate produced by the Pace MRR model.

Oct 2021 estimates (Pace MMR model)	
Year	**Estimated mortality**
2015	29
2016	30
2017	44*
2018	21*
2019	33
2015-2019	157

Calculate annual average estimated mortality

$$\frac{157}{5 \text{ years}} = 31.4/\text{year}$$

*In previous estimates, 2017 was 42 and 2018 was 17

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Risk reduction calculations

Use the observed M/SI ratio to apportion the total mortality estimate produced by the Pace MRR model.
Across three assumptions: 50%, 40%, or 30% US.

Country Apportionment	(a) PBR - draft 2021 SAR	(b) Annual average estimated mortality for 2015-2019	(c) Assumed US proportion
50% US/ 50% CAN			0.50
40% US/ 60% CAN	0.7	31.4	0.40
30% US/ 70% CAN			0.30

Risk reduction calculations

Use the observed M/SI ratio to apportion the total mortality estimate produced by the Pace MRR model. Across three assumptions: 50%, 40%, or 30% US.

Country Apportionment	(a) PBR - draft 2021 SAR	(b) Annual average estimated mortality for 2015-2019	(c) Assumed US proportion	(d) US mortality based on country assumption (b*c)
50% US/ 50% CAN			0.50	**15.7**
40% US/ 60% CAN	0.7	31.4	0.40	**12.6**
30% US/ 70% CAN			0.30	**9.4**

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Risk reduction calculations

Use the observed M/SI ratio to apportion the total mortality estimate produced by the Pace MRR model. Across three assumptions: 50%, 40%, or 30% US.

Country Apportionment	(a) PBR - draft 2021 SAR	(b) Annual average estimated mortality for 2015-2019	(c) Assumed US proportion	(d) US mortality based on country assumption (b*c)	(e) US mortality - 70% EN Observed M/SI for 2016-2020 (d* 0.70)
50% US/ 50% CAN			0.50	15.7	11
40% US/ 60% CAN	0.7	31.4	0.40	12.6	8.8
30% US/ 70% CAN			0.30	9.4	6.6

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Risk reduction calculations

Use the observed M/SI ratio to apportion the total mortality estimate produced by the Pace MRR model. Across three assumptions: 50%, 40%, or 30% US.

Country Apportionment	(a) PBR - draft 2021 SAR	(b) Annual average estimated mortality for 2015-2019	(c) Assumed US proportion	(d) US mortality based on country assumption (b*c)	(e) US mortality - 70% EN Observed M/SI for 2016-2020 (d* 0.70)	(f) % Reduction Needed for US to achieve PBR assuming 70% is EN ((e-a)/e)
50% US/ 50% CAN			0.50	15.7	11	**93.6%**
40% US/ 60% CAN	0.7	31.4	0.40	12.6	8.8	**92.0%**
30% US/ 70% CAN			0.30	9.4	6.6	**89.4%**

Risk reduction calculations

Use the observed M/SI ratio to apportion the total mortality estimate produced by the Pace MRR model.
Across three assumptions: 50%, 40%, or 30% US.

Country Apportionment	(a) PBR - draft 2021 SAR	(b) Annual average estimated mortality for 2015-2019	(c) Assumed US proportion	(d) US mortality based on country assumption (b*c)	(e) US mortality - 70% EN Observed M/SI for 2016-2020 (d* 0.70)	(f) % Reduction Needed for US to achieve PBR assuming 70% is EN ((e-a)/e)
50% US/ 50% CAN			0.50	15.7	11	93.6%
40% US/ 60% CAN	0.7	31.4	0.40	12.6	8.8	92.0%
30% US/ 70% CAN			0.30	9.4	6.6	89.4%

To be at PBR level, those 11 assumed US entanglements would need to be reduced by 10.3 or ~94%.

$$\frac{11 - 0.7}{11} = 93.6\%$$

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Questions
Use the 'Questions' box to get in line

Providing Public Comment

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Speaking:
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- When you are called on, we will un-mute you, and then you will need to un-mute yourself.
- I will hold up my hand when you have 30 seconds left and will let you know verbally when your time is up.
- We reserve the right to mute anyone who violates our ground rules or if you are over time.

REMINDER: Today's event is being recorded (including anything typed into the questions box) and will be available through the event registration page after the meeting.

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Future Meetings

- December 1 & 2, 2021
  - 2:00-6:00 PM ET
- January 11 - 13, 2022
  - Hybrid meeting canceled, but hold for potential webinars
- March 28 - April 1, 2022
  - Hold these dates for a full team meeting
- DST webinar - Date TBD

#3720 and 2021 calf. Credit: Clearwater Marine Aquarium Research Institute, taken under NOAA permit #20556-01