

# Re-sights & survival of entangled humpbacks & other large whales within the CA-OR-WA region using photo-id & long-term life history data

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All images taken under NOAA Permits #18786, #16111, & #21678 unless otherwise noted

# Demography of entangled humpback whales with life history data

Cases from 1982 through 2019 = **217**

Cases with photo-id images = **53**

Cases with individuals documented outside of their entanglement = **35**

Cases from 1982-2017 available for opportunity for re-sight analysis = **37**

- Known **sexes** of entangled whales (n=8):
  - 7 females, 1 male
- Known **exact ages** of entangled whales (n=6):
  - 2 calves, 3, 10, 11, and 19 years old
- Known **DPS** of entangled whales, based on photo-id matches to breeding grounds (n=15):
  - Central America- 6
  - Mexico- 9
  - Hawaii- 0



## Take away:

- Challenge: This data is bias towards entanglement configurations that allows the whale to bring its flukes above the surface of the water; therefore, the data likely underrepresents anchored, hogtied, or severely compromised whales.
- Solution: Recent data is more inclusive of individuals regardless of their entanglement configuration due to real-time reports with stand-by vessels which allows trained response teams to obtain photo-ids though underwater documentation.



# Take away: Life history data provides information about individual survival, site fidelity, and demographic information

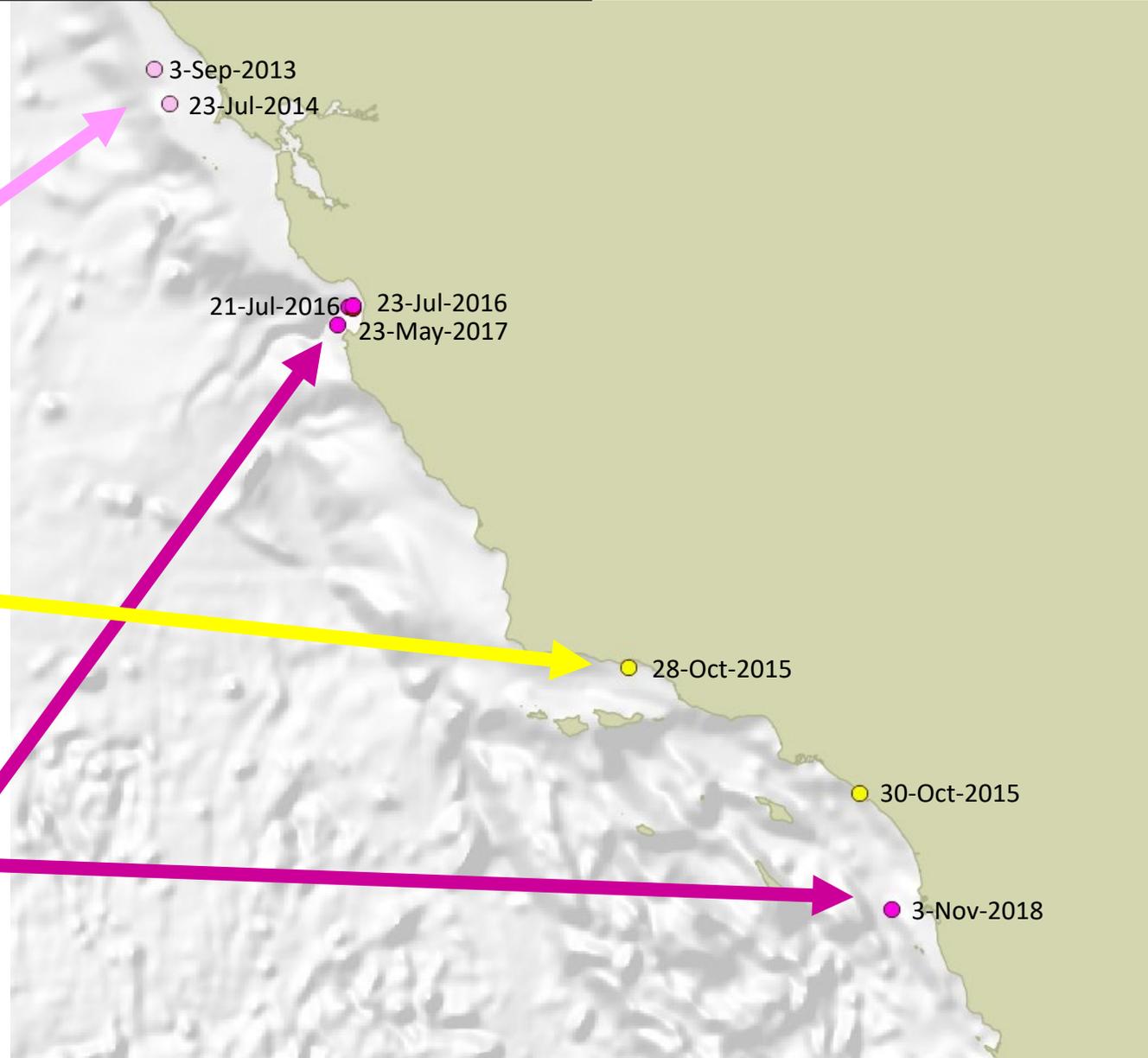
Pre-entanglement



During entanglement



Post-entanglement



# Take away- Our analysis used control groups based on region and time period of the report to provide comparisons to the entangled whales

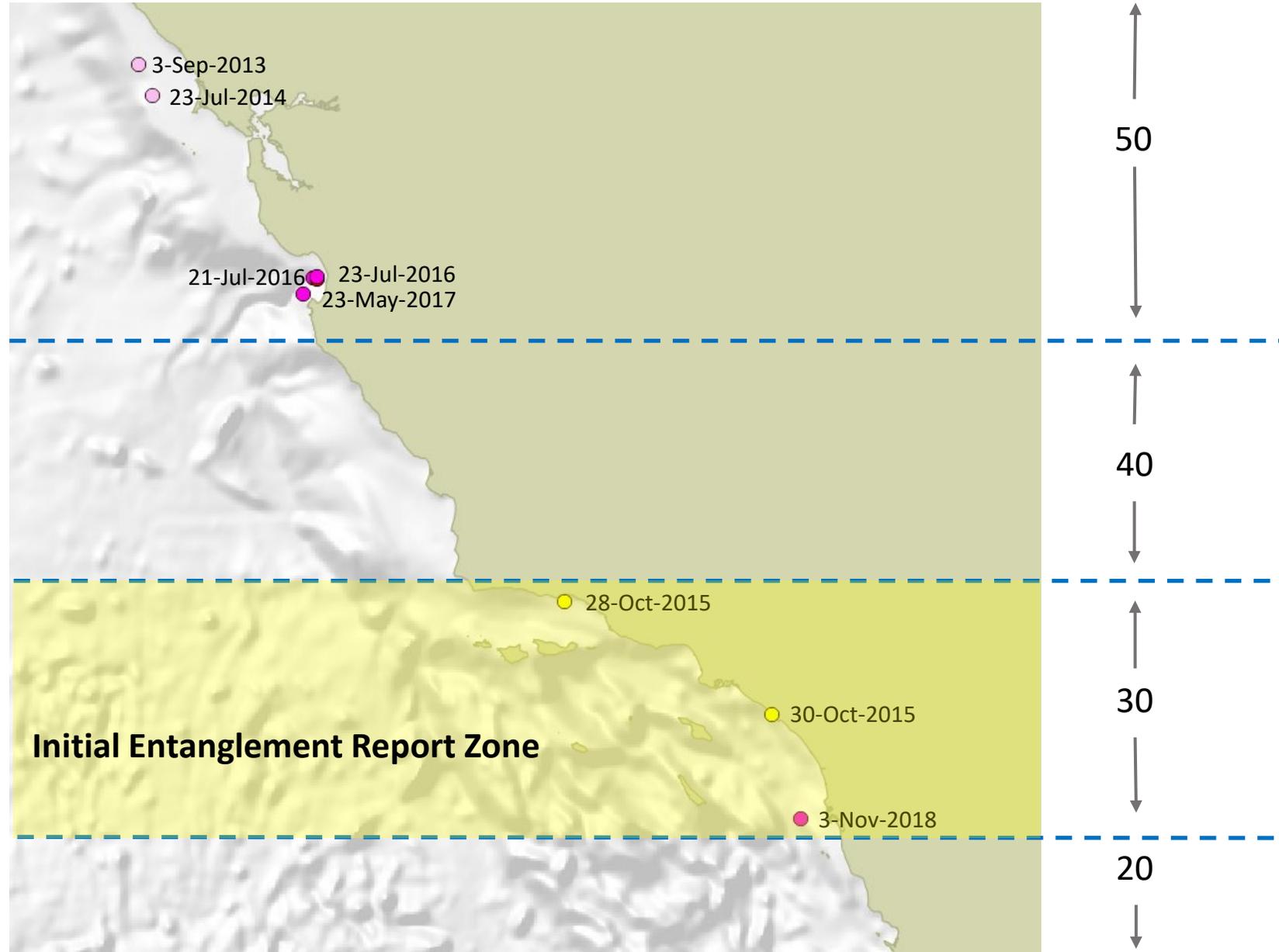
Pre-entanglement

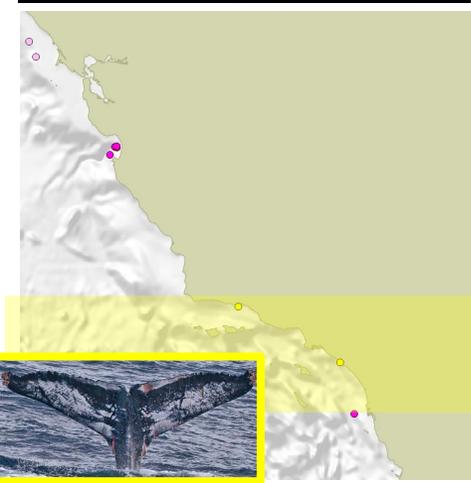
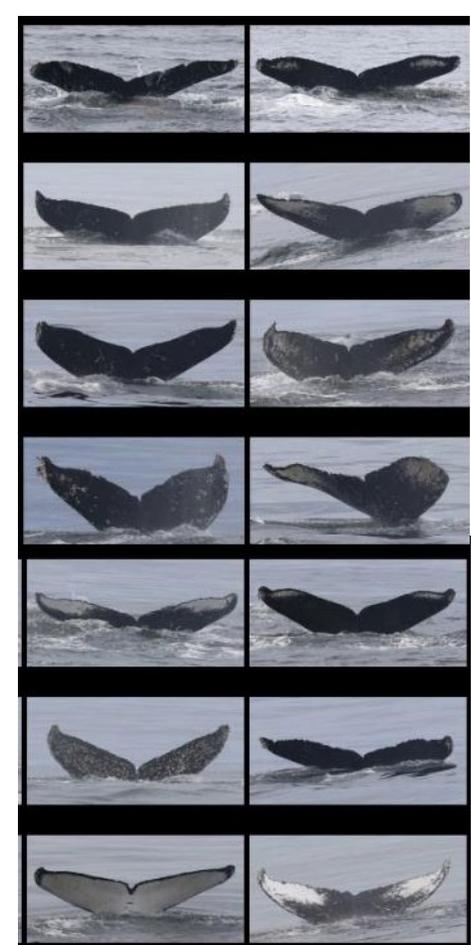


During entanglement

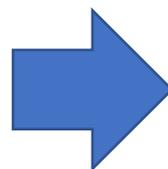
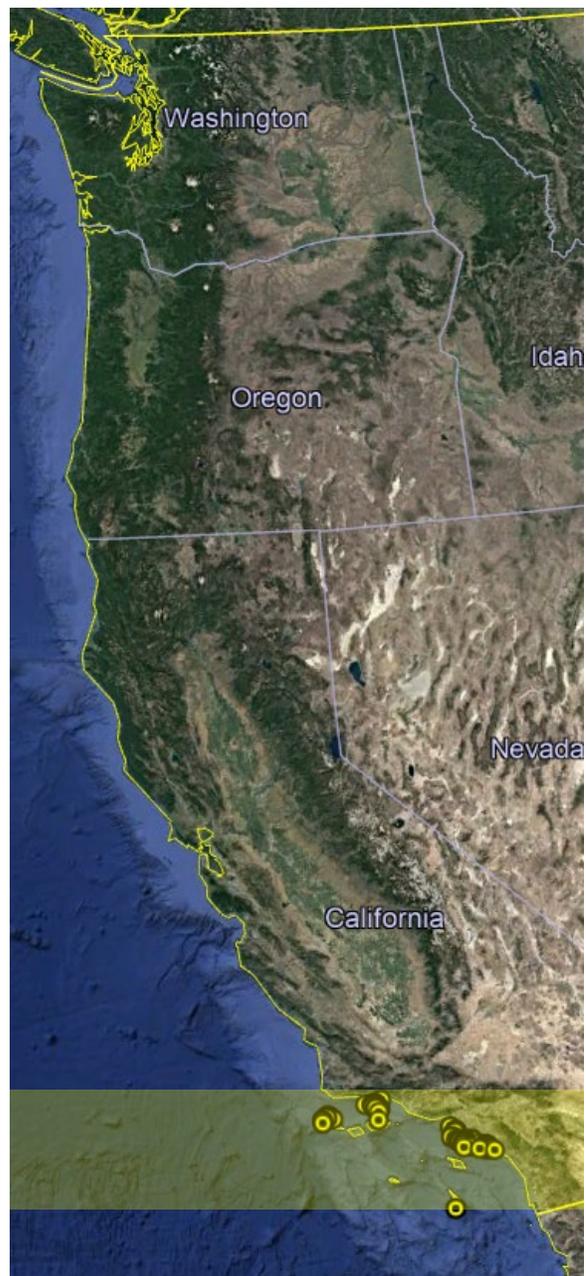


Post-entanglement

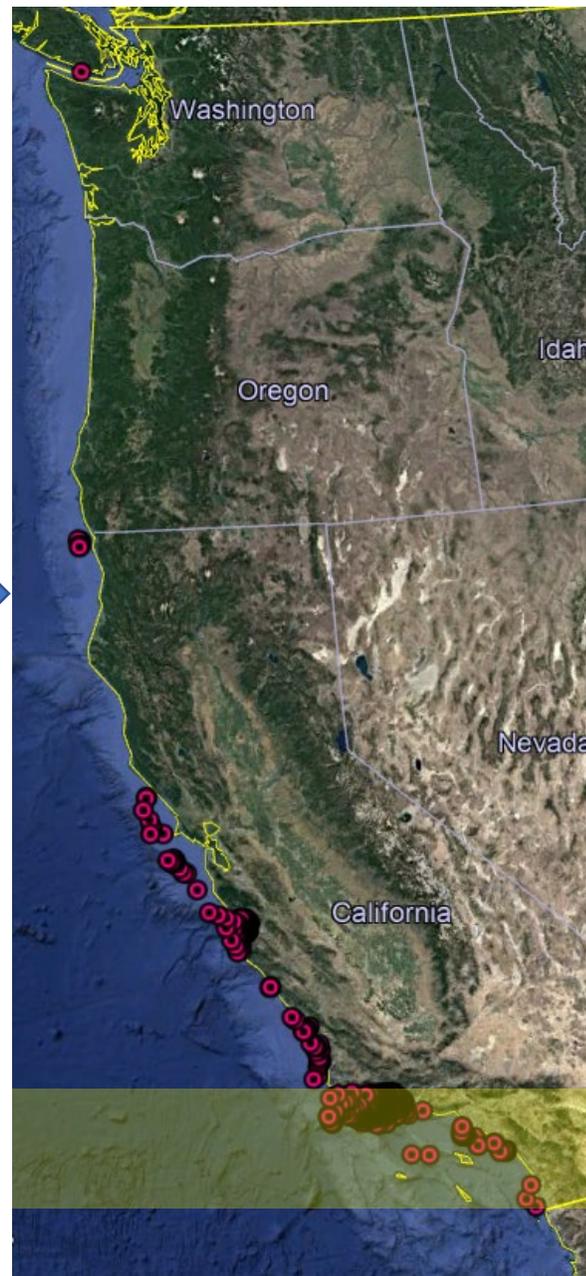




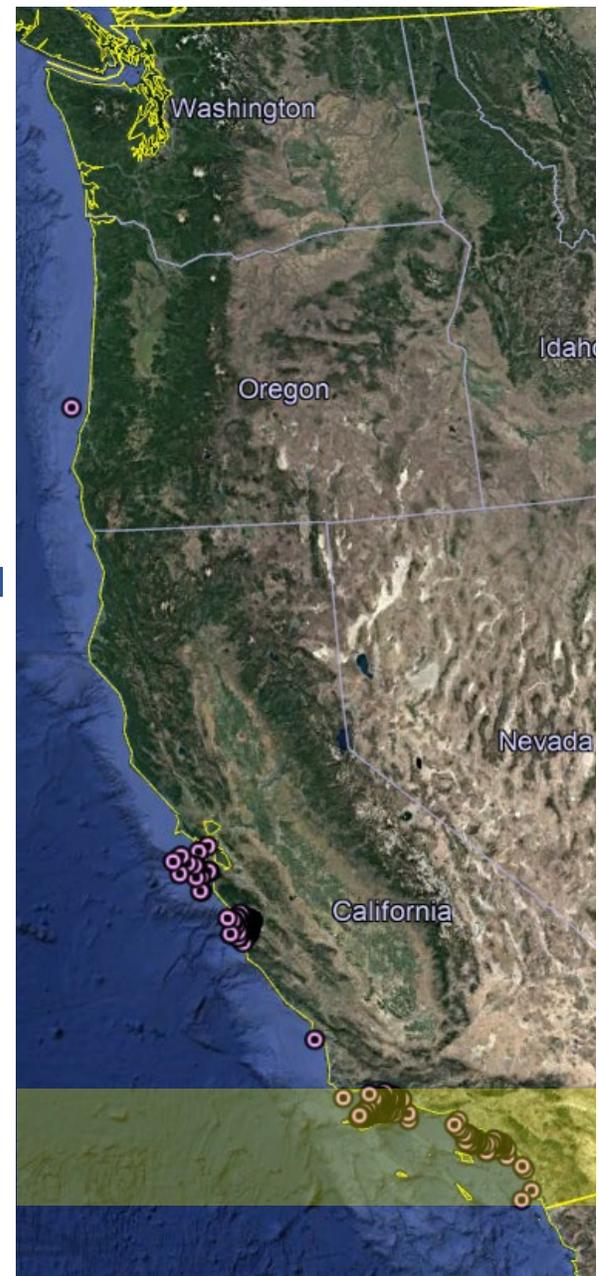
Control group  
during entanglement year  
2015



Control group  
post-entanglement year  
>2015



Control group  
pre-entanglement year  
<2015

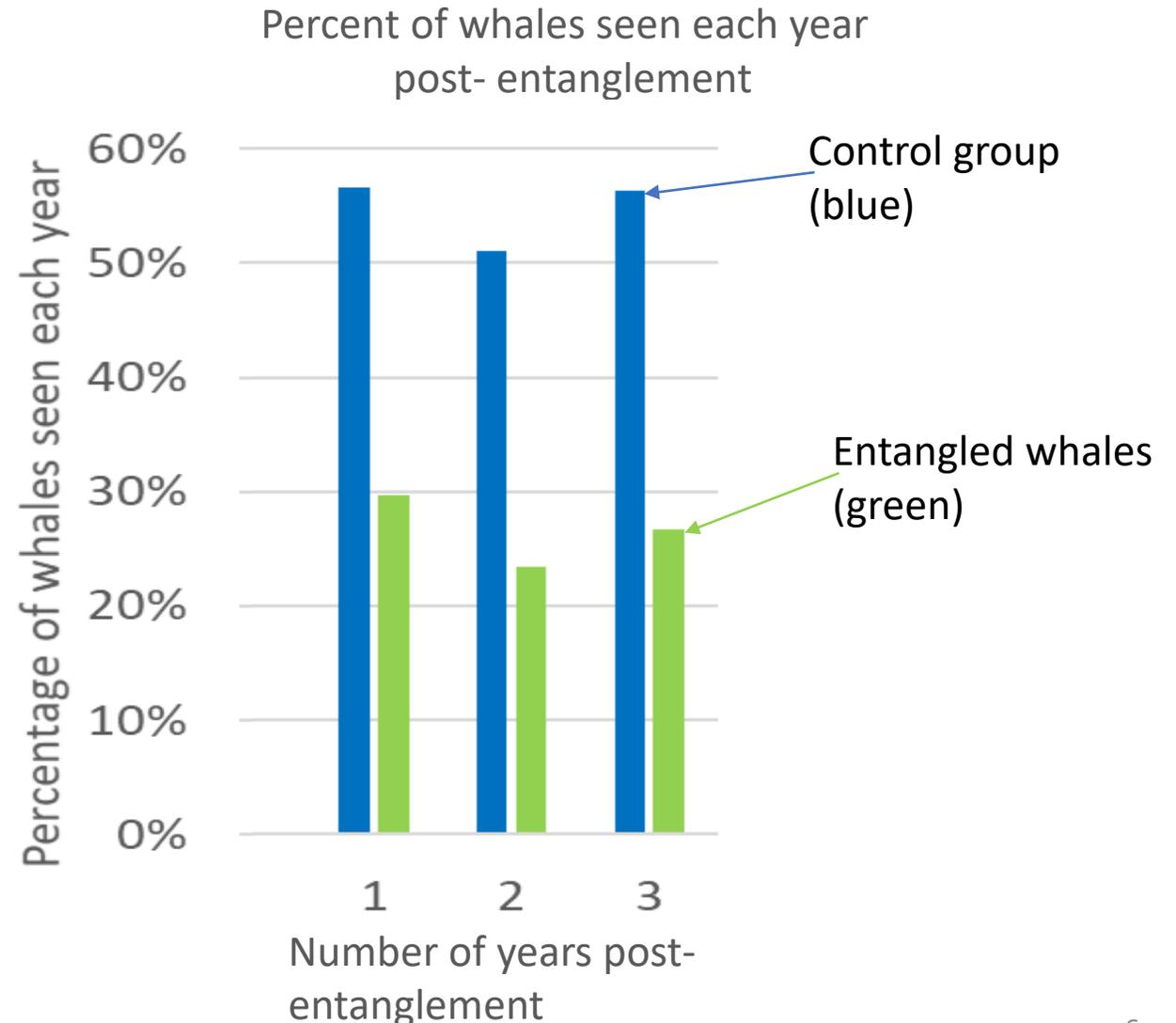


# Take away: Entangled whales are seen less often and are known to be alive for a smaller percentage of time than “control” whales

## Pooled data post-entanglement:

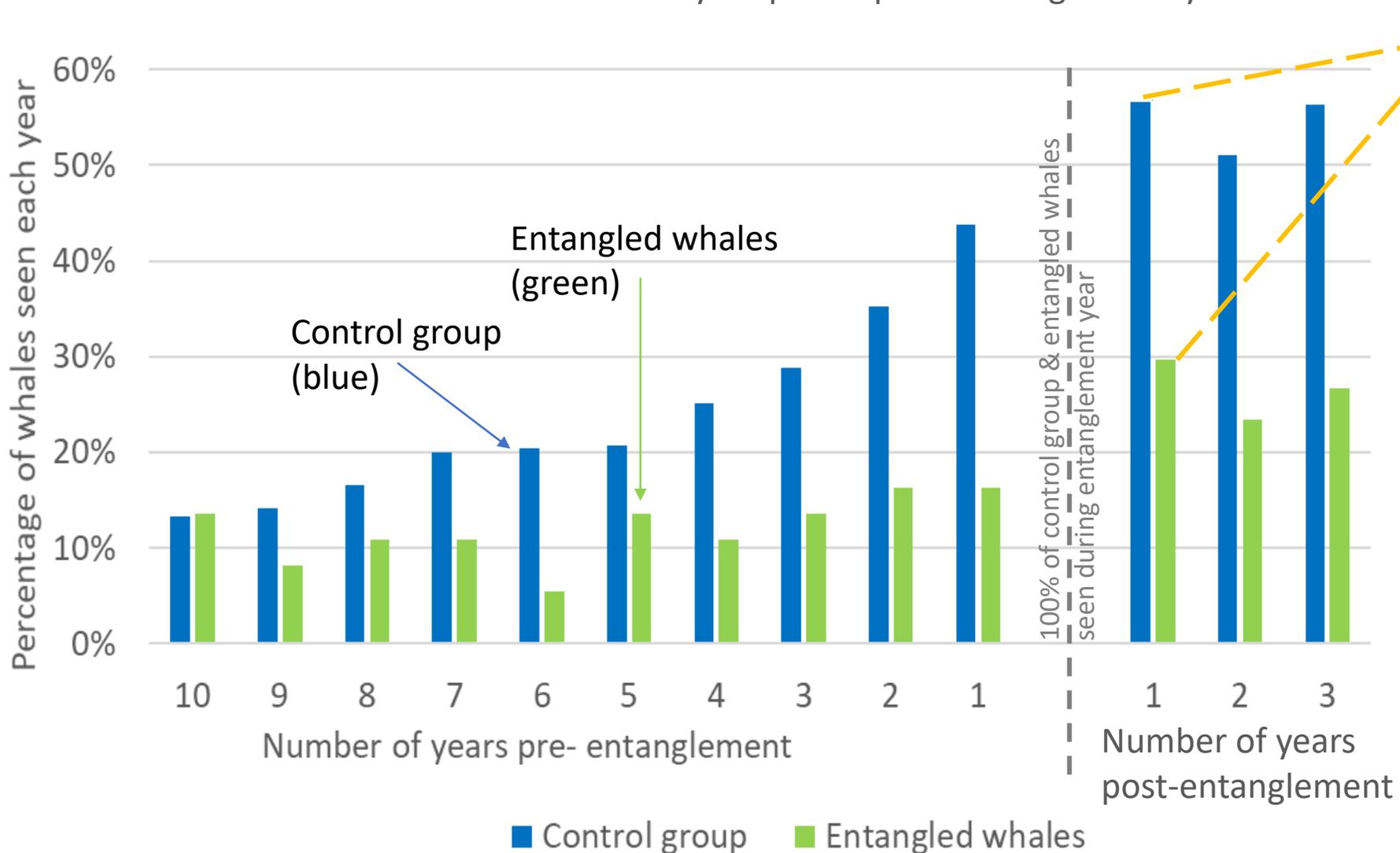
1. Percentage of years seen:  
Entangled whales- 33.9%  
Control group- 51.1%  
Chi square,  $x^2=14.346$ ,  $df=1$ ,  $p= 0.0002$

2. Percentage of years known to be alive:  
Entangled whales- 55.4%  
Control group- 66.2%  
Chi square,  $x^2=6.3344$ ,  $df=1$ ,  $p= 0.0118$



# Take away: Further questions arose....

Percent of whales seen each year pre- & post- entanglement year

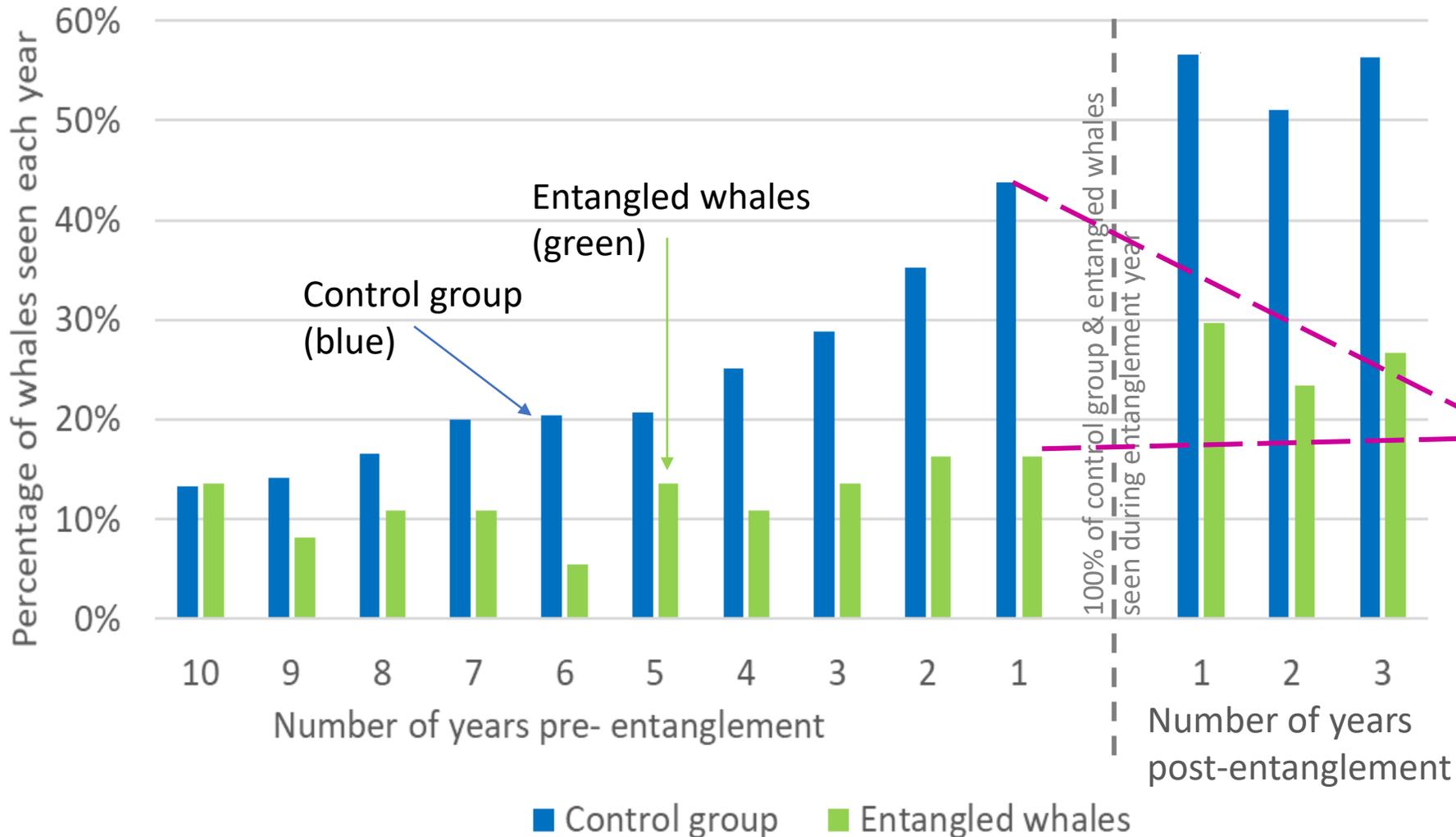


Could this be explained by “out-of-habitat” whales?

Spoiler alert: Nope, whales are not from other populations

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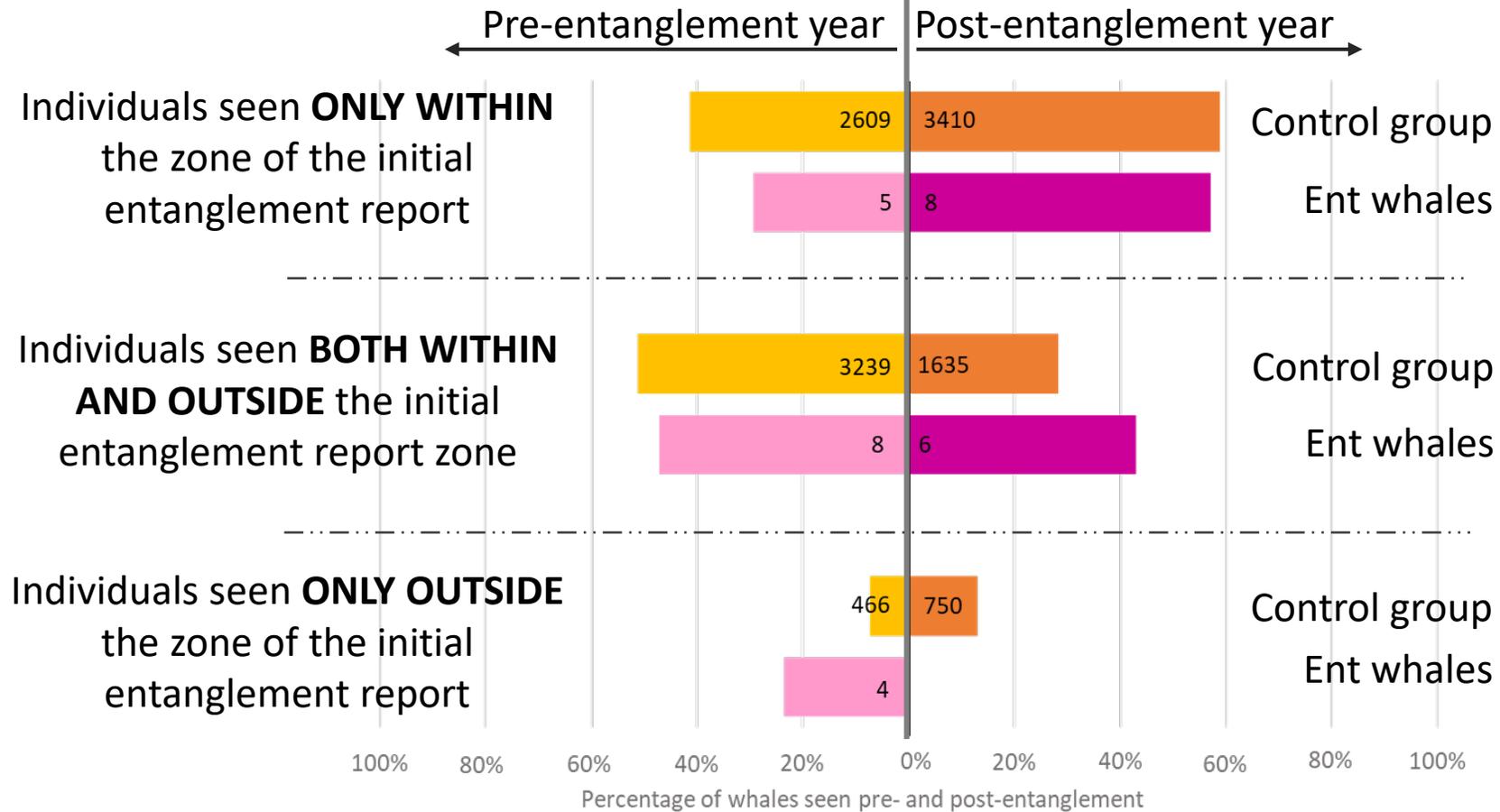


Could this be explained by “out-of-habitat” whales?

Spoiler alert: Nope, likely they weren't seen b/c they weren't alive

# Take away: The lower re-sighting of entangled whales is NOT because they are individuals from outside the CA-OR-WA region

Pre- & post-entanglement sighting locations based on the initial entanglement report region

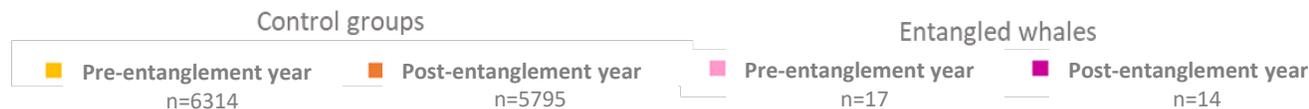


Within the CA-OR-WA region:

- After the entanglement year, whales are re-sighted in the same zone in which they were seen while entangled.

Outside of the CA-OR-WA region:

- Supplemented the CRC catalog with Happywhale resights from outside of the west coast region and determined that entangled whales with short- or no pre-entanglement sighting histories had not been seen outside of the CA-OR-WA region.



**Take away:** Entangled whales are more likely to be re-sighted post-entanglement when the initial report occurs in the same region as where the entangling gear was set.

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	Number of opportunity years	% of years individuals seen after entanglement year	% of years individuals known to be alive after entanglement year
Reported inside the same region gear was set (n=9)	28	29%	50%
Reported outside of the state gear was set (n=3)	7	0%	0%

- The percentage of years the animals were known to be alive is higher than expected when the gear and initial report are from the same region (Fisher's Exact test  $p=0.016$ ).
- The distance between where the gear was set and where the initial report occurred should not be confused with duration of the entanglement.
- Less than half of the cases could be tied to a fishery. Better marking systems across multiple fisheries would provide data for better estimates of re-sights.

**Take away:** Entangled whales tend to have shorter histories of sightings pre-entanglement than the “control” whales, possibly reflecting that entangled whales tended to be younger animals.

	Not seen prior to entanglement year	First seen <u>only</u> 1-3 years prior to entanglement year	First seen 4 or more years prior to entanglement
Entangled whales (n=37)	54% <sup>1</sup>	14% <sup>1</sup>	33% <sup>2</sup>
Control Group (n=8256)	24%	15%	62%

<sup>1</sup> including 1 known aged individual <sup>2</sup> including 3 known aged individuals  
 $\chi^2=13.298, df=1, p= 0.0003$

- Previous studies on humpback whales on the east coast found that juveniles in general have a higher mortality rate than mature whales (Robbins 2007, Rosenbaum et al., 2002), and are more likely to become entangled (Robbins 2009).

Sighting history length pre-entanglement as a proxy for age class:

- **Mature** - seen 4 or more years prior to the entanglement year (therefore at least 5 years old during its entanglement).
- **“Likely Juvenile”**- not seen prior to 3 years before its entanglement year (Robbins 2007).

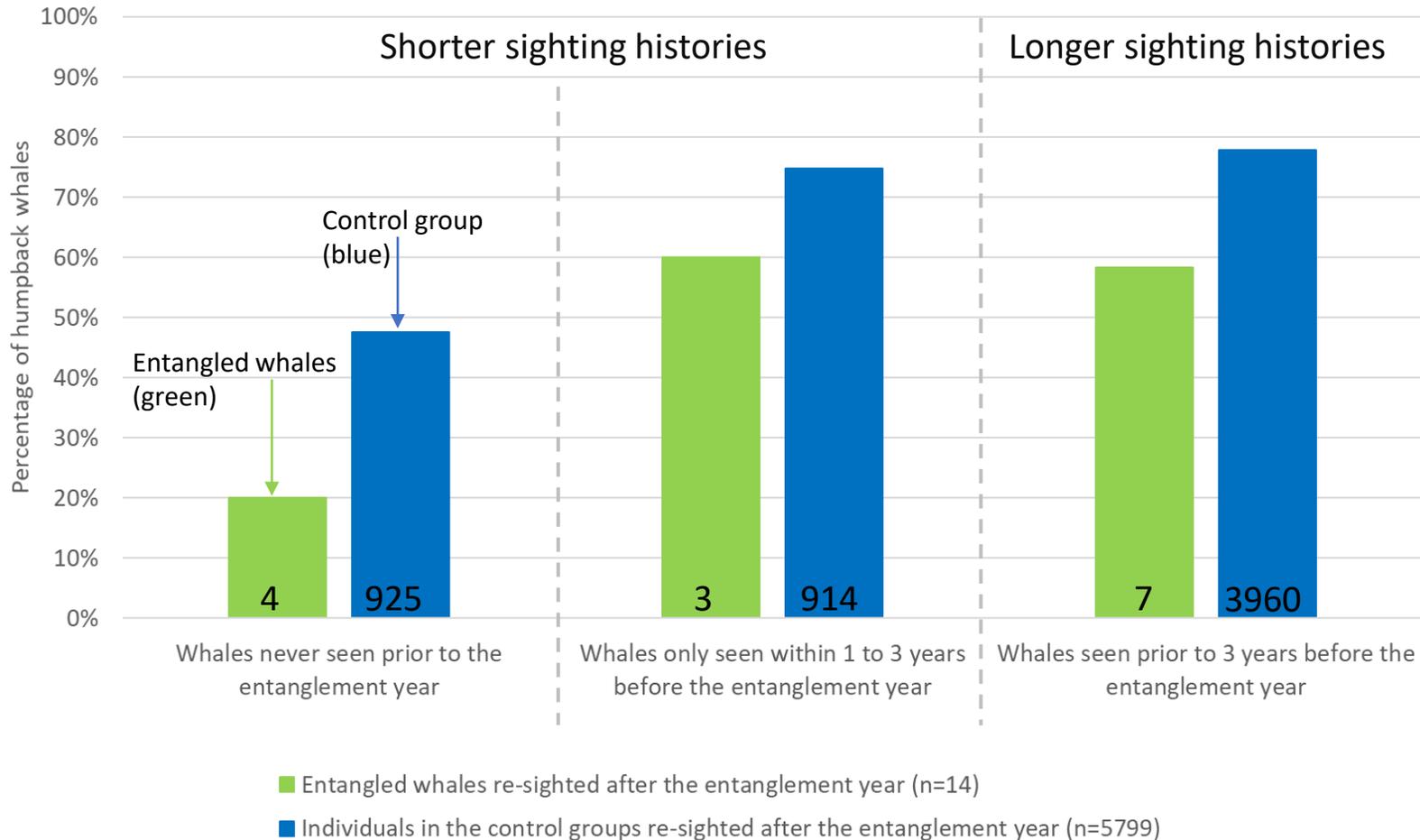
Robbins, J. (2007). *Structure and dynamics of the Gulf of Maine humpback whale population* (Issue March) [University of St. Andrews]. <http://hdl.handle.net/10023/328>

Robbins, J. (2009). Scar-based inference into Gulf of Maine humpback whale entanglement: 2003-2006. In *Report to the Northeast Fisheries Science Center National Marine Fisheries Service* (Issue EA133F09CN0253).

Rosenbaum, H. C., Weinrich, M. T., Stoleson, S. A., Gibbs, J. P., Baker, C. S., & DeSalle, R. (2002). The effect of differential reproductive success on population genetic structure: Correlations of life history with matriline in humpback whales of the Gulf of Maine. *Journal of Heredity*, 93(6), 389–399. <https://doi.org/10.1093/jhered/93.6.389>

# Take away: Although many of the entangled whales are likely younger whales, sighting history length does **NOT** account for the difference in re-sight rates between entangled whales and “control” whales

Percentage of whales seen post-entanglement grouped by their sighting history length as a proxy for age-class



- Whales without a pre-entanglement sighting history were less likely to be re-sighted post-entanglement, regardless of whether they were entangled or not.
- Regardless of sighting history length, a smaller percentage of entangled whales are re-sighted post-entanglement, compared to “control” whales.

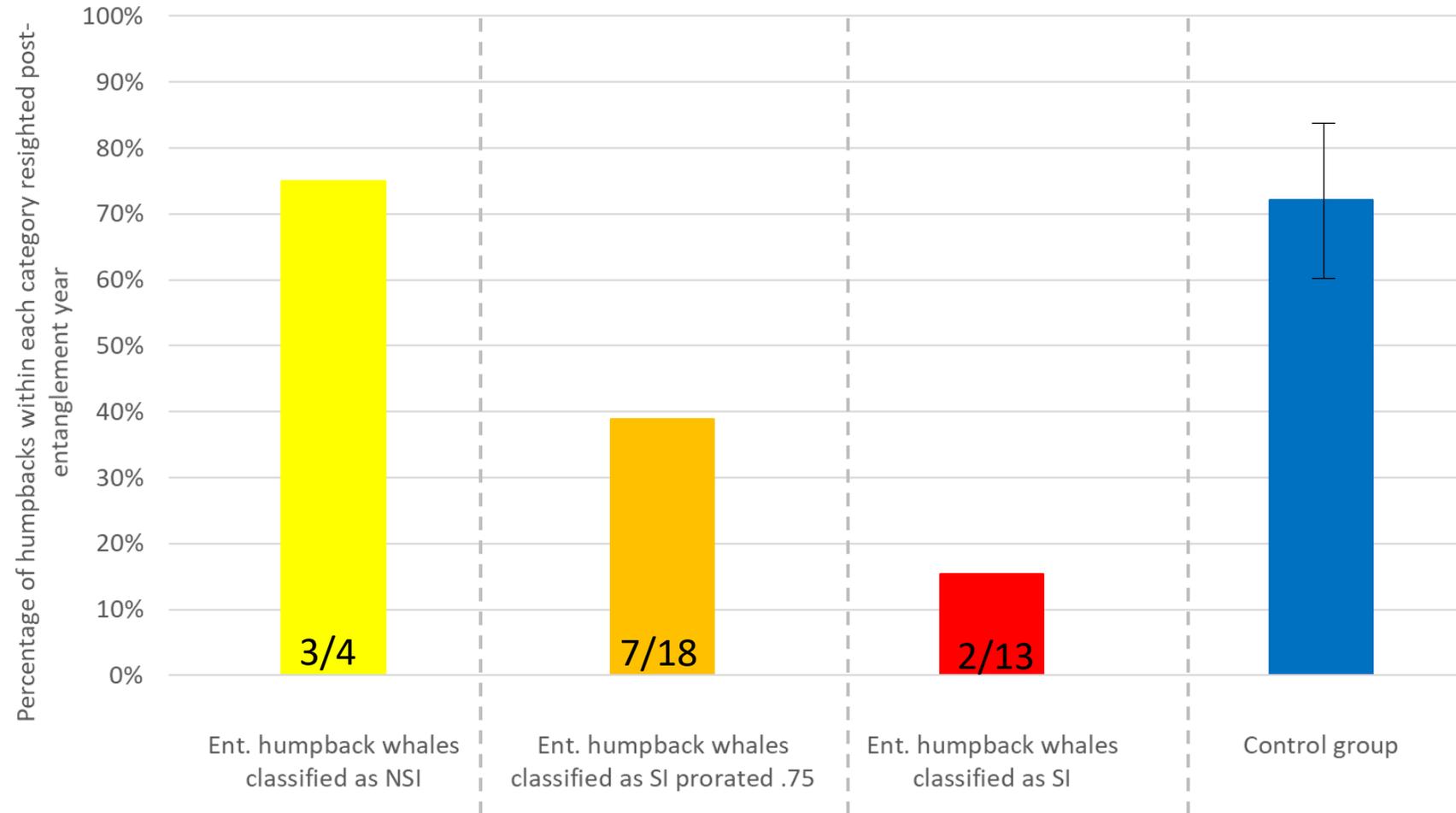
# Take away: The re-sighting of whales post-entanglement generally correlated with the initial Serious Injury score assigned by NOAA

- Of the 37 entangled humpback whales with known Id's, 35 of them were given an initial serious injury/mortality classification by SWFSC/NOAA:

NSI- non-serious injury NSI

SI prorated .75- serious injury prorated .75

SI- serious injury

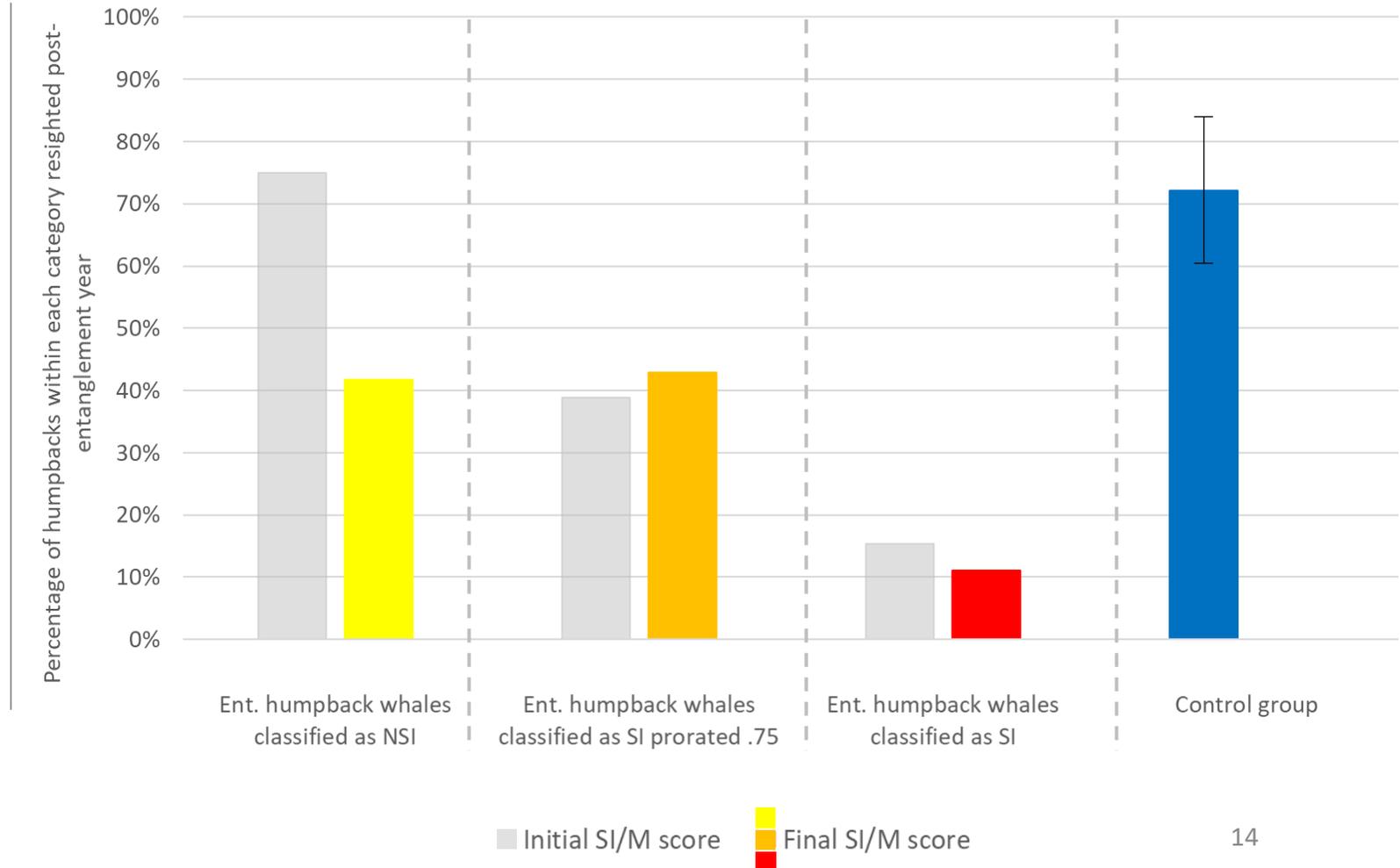


# Take away: Final score did not correlate as well as the initial SI score

Changes of classification due to actions/reports:

	<u>Initial</u>		<u>Final</u>
NSI:	4	↑	12
SI prorated:	18	↓	14
SI:	13	↓	9

- Final scores do not correlate as well, but further analysis is needed to determine what is causing the disconnect.
  - Duration of entanglement
  - Sublethal effects
  - Not complete “self-release”



# Gray whale & blue whale entanglements

Species	# of confirmed entanglements cases	# of cases with images	# of cases with ID images good enough to be matched	# of cases with CRC ID
Gray whales	228	42	11	7
Blue whales	7	4	3	3

## Gray whales:

- 5 of the 7 identified whales were PCFG's
- Only 2 of the 7 have been re-sighted, both PCFG's
- Age of entangled whales ranged from calf to at least 17 years old
- Unlike blues and humpbacks, gray whales have been documented with the same entanglement across multiple years- one was entangled for at least 3 years.

## Blue whales:

- Only 1 of the 3 has been re-sighted
- All adults that were first seen at least 20 years prior to their entanglement



# Gaps in our knowledge that can be filled by Photo-id data

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## 1. Sub-lethal effects of entanglements:

- Reduce reproductive success
- Delay age of first reproduction

## 2. Short-term vs long-term effect of entanglements:

- The effects of capture myopathy (permanent muscle damage)
- Time to return to normal behavior

## 3. Influence of time of year and duration of the entanglement on the survival rate.

# Increased efforts to collect photo-ids of entangled whales paired with better gear marking can help highlight...

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1. If certain gear types have higher or lower survival rates than other types.
2. What are the health effects or injuries caused by entanglements of different durations.



# Thank you & Acknowledgements

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- Support by NOAA including through a Section 6 grant to WDFW
- Everyone who has reported an entanglement, especially those who stood-by the animal until a response team arrived
- All of the responders who have participated in trainings and used those skills to collect data about entanglements
- All of the contributors to the Cascadia Research humpback whale long-term study and Happywhale.

