

Status of the North Atlantic Right Whale: 2017



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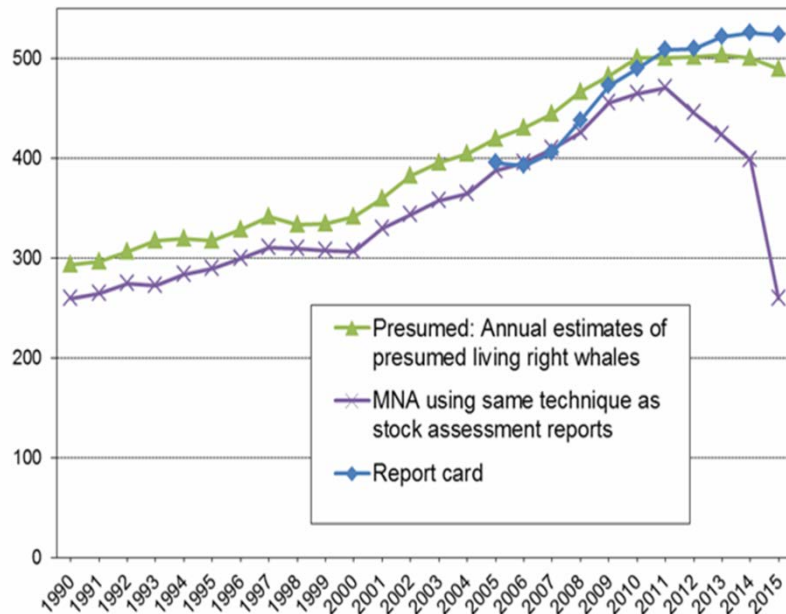
Research on NA Right Whales

Aerial and Shipboard Surveys

- Counts
- Distribution
- Abundance
- Morphometrics
- Photo-ID
- Reproduction
- Population assessments
- Demography
- Health Data
- Scarring Data

- Necropsies
- Disentanglements
- Biopsy Sampling
- Genetics
- Contaminants
- Drones
- Tagging
- Acoustics
- Oceanography

- Health Assessments
- Fecal sampling
- Hormones
- Biotoxins
- Prey Species
- Parasites/Disease
- Breath Sampling
- Hormones
- Microbiome

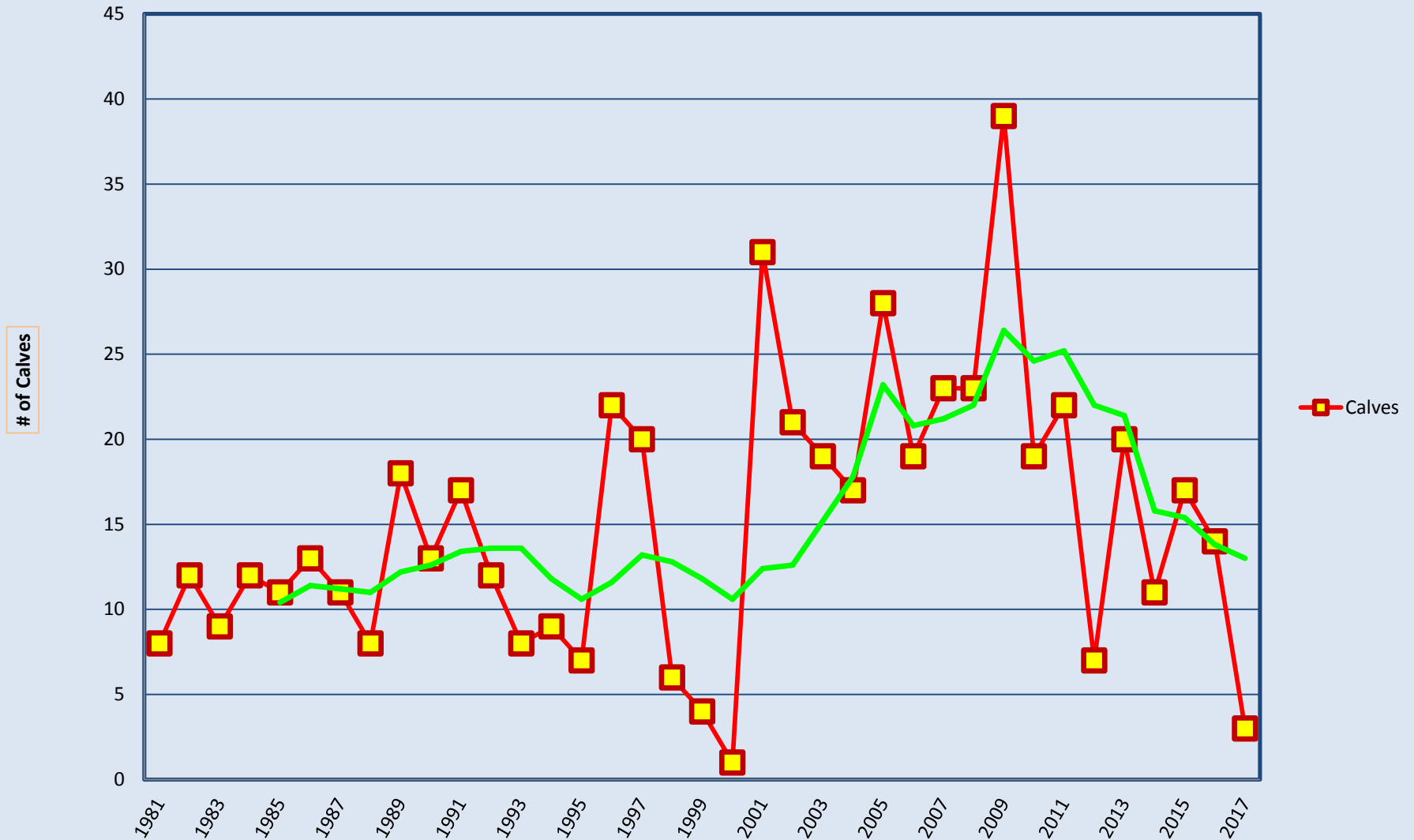


Pettis, H.M. and Hamilton, P.K. 2016. North Atlantic Right Whale Consortium annual report card. Report to the North Atlantic Right Whale Consortium, November 2016.

For a more robust population analysis, see: **Corkeron et al., Next Talk**

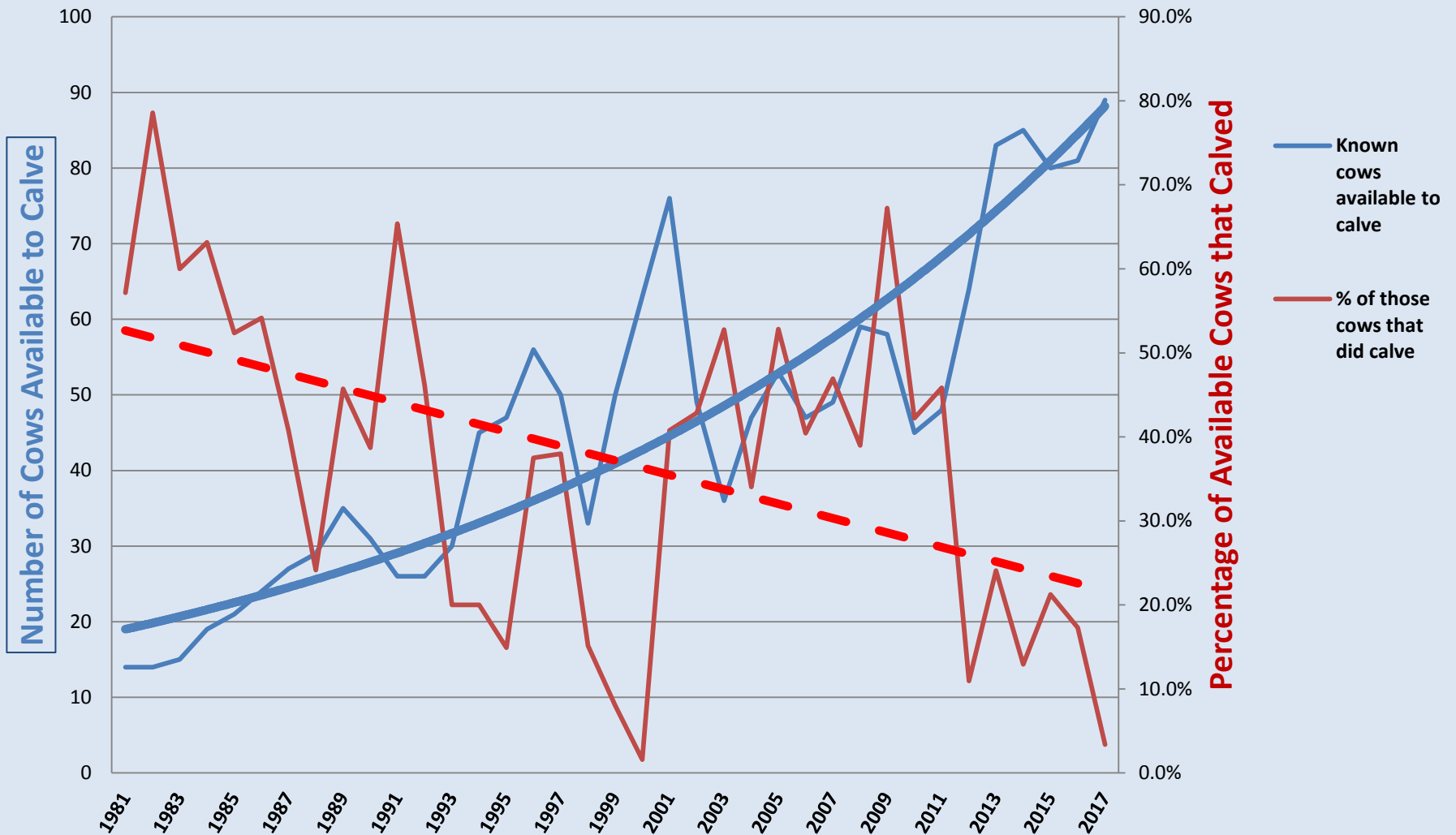
Reproduction, Part 1: Right Whale Catalog Data through 2017

Calves per Year



Reproduction, Part 2: Right Whale Catalog Data through 2017

Number of Right Whale Cows and % of Cows that Successfully Calved



Factors Affecting Right Whales

Gear Entanglement
Vessel strikes
Climate change
Disease
Food limitation
Ocean Noise
Red Tides
Genetic inbreeding
Chemical Pollution
Pharmaceutical effluent



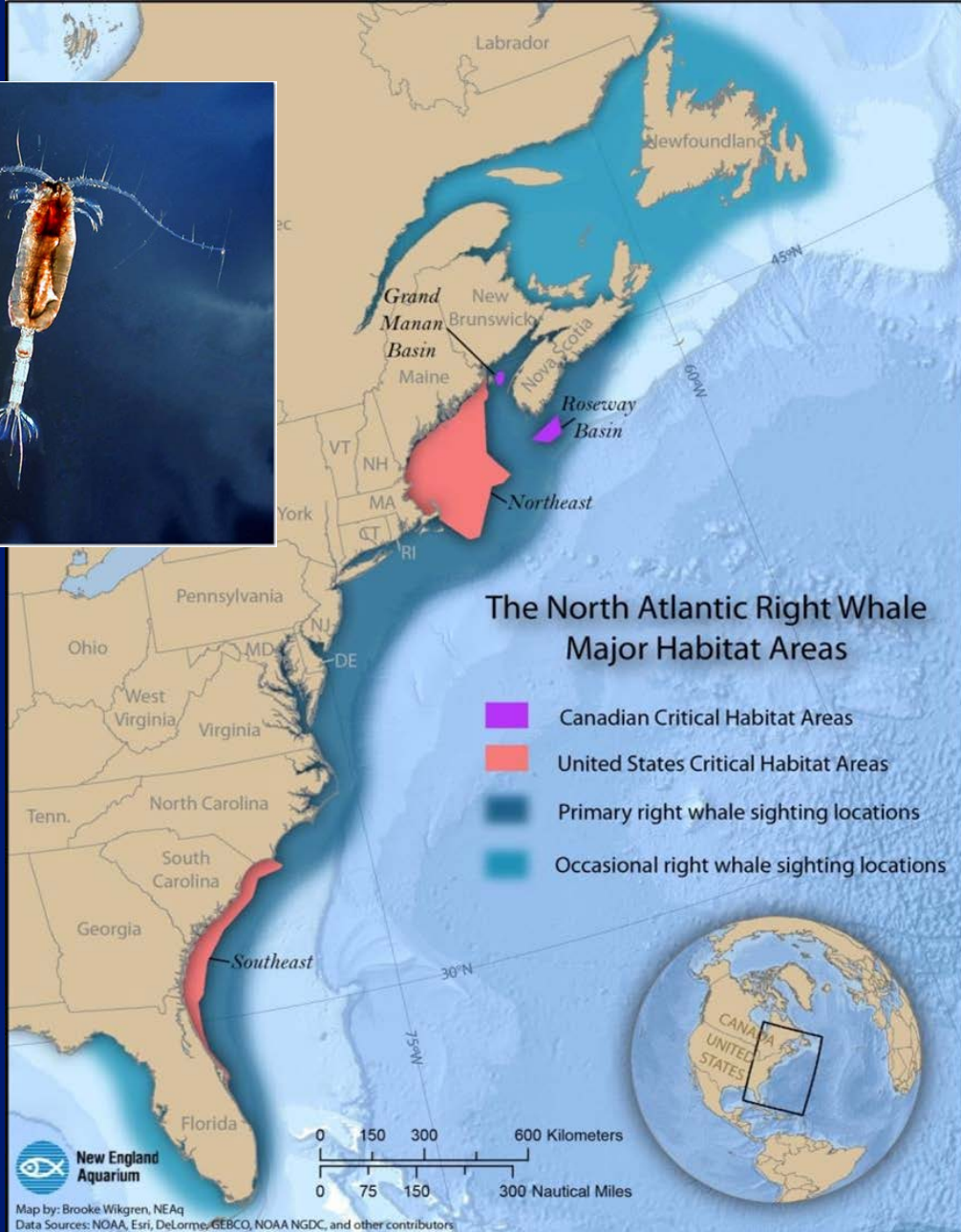
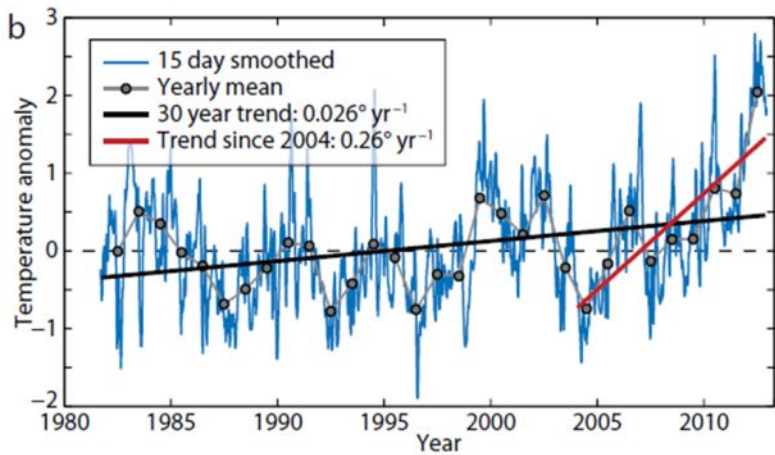
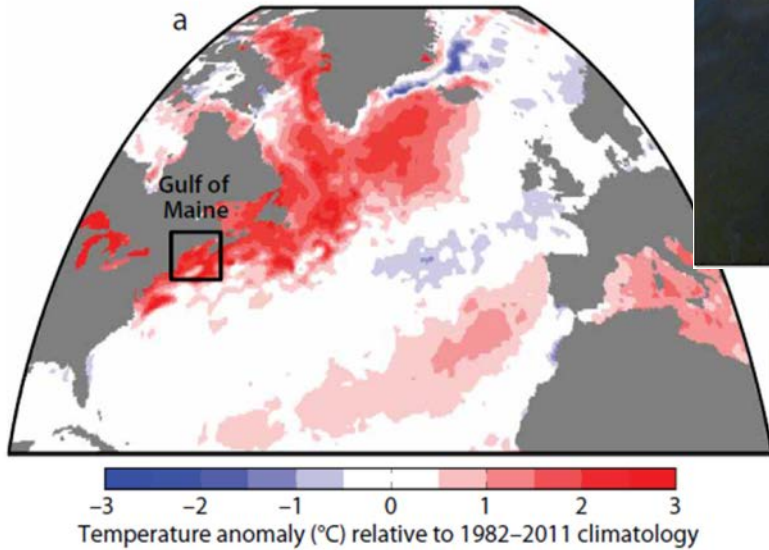
EFFECTS

Health
Reproduction
Mortality

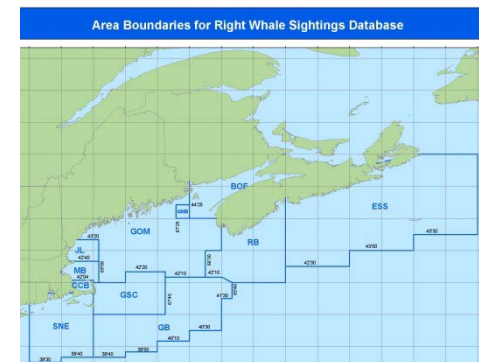
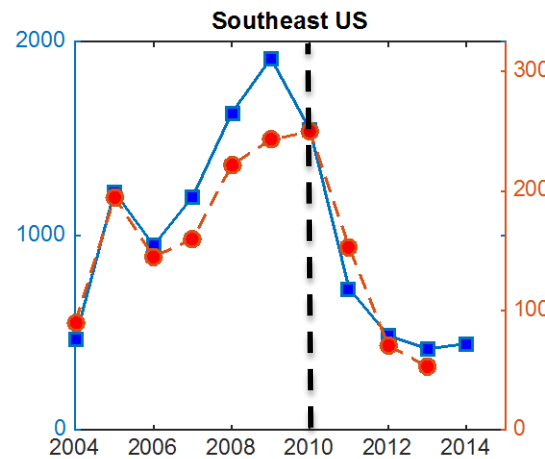
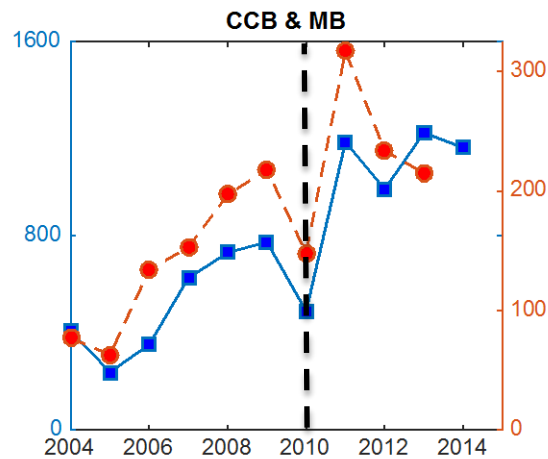
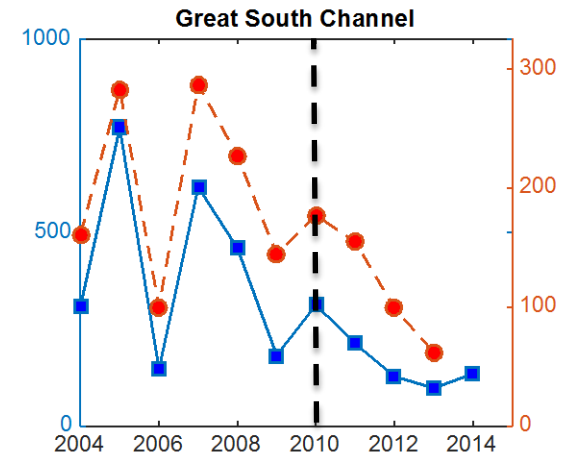
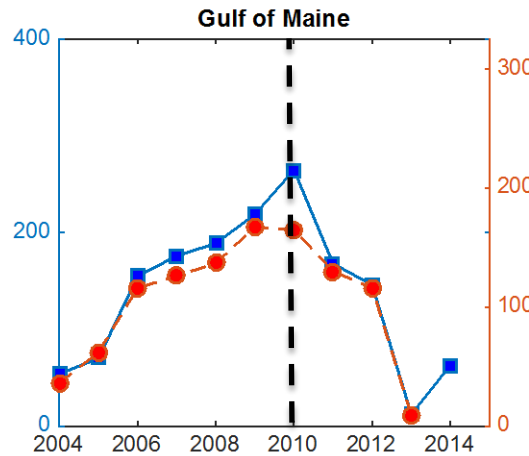
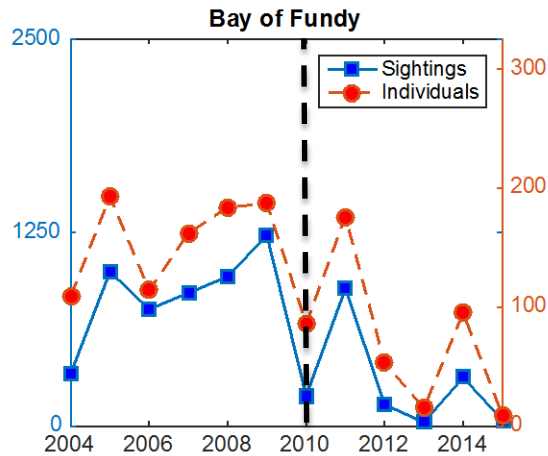
CONSEQUENCES

Population fitness
Population survival
Ecosystem effects

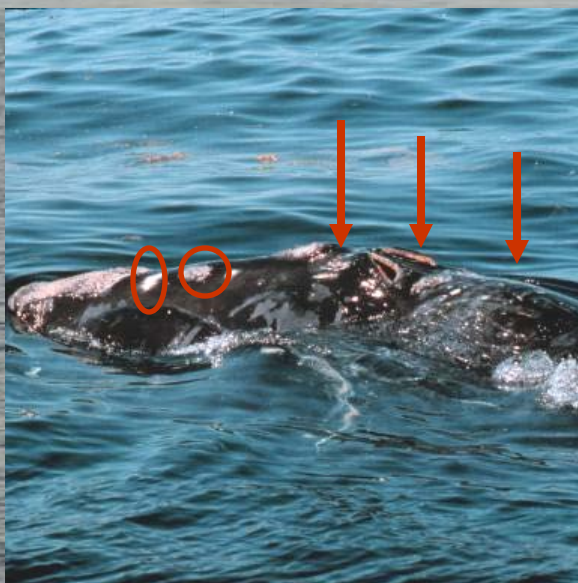
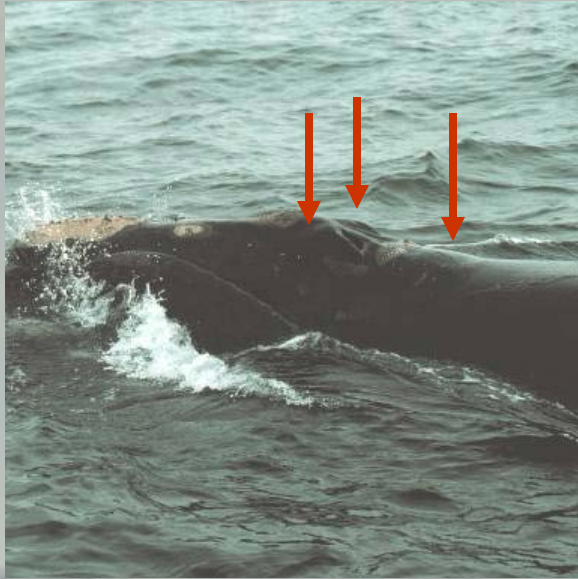
Climate Change Effects?



New patterns emerging



Visual Health Assessment Database

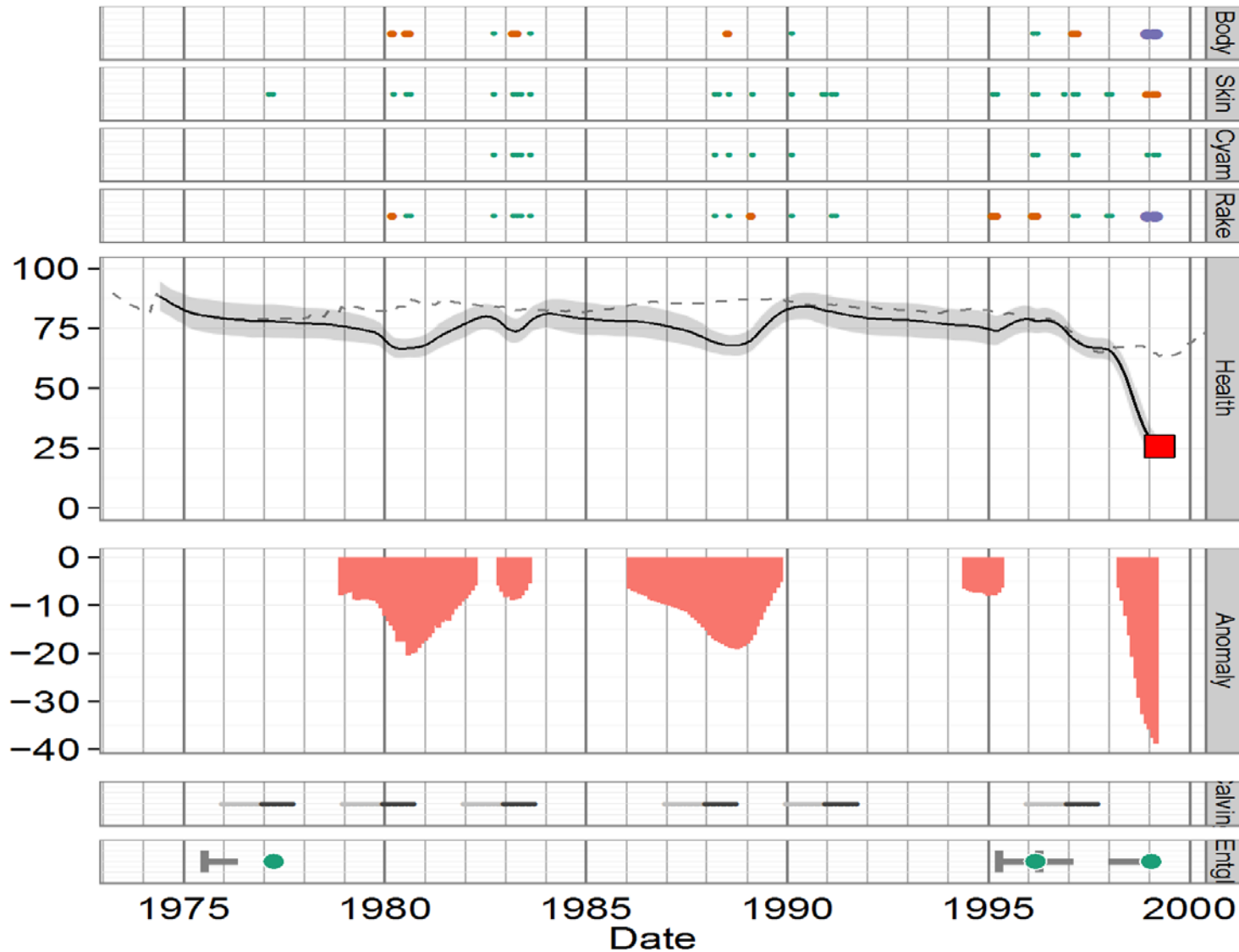


- **4 physical parameters are scored**
 - Body condition (1-3 scale)
 - Skin condition (1-2)
 - Blowhole cyamids (1-2)
 - Rake marks in front of blowholes (1-3)
- **All images of a whale grouped by habitat and year for scoring (“Batch”).**

- **Health Data from 1980-2014:**
 - 48,560 sightings
 - 622 individual whales

Pettis, H.M., R.M. Rolland, P.K. Hamilton, S. Brault, A.R. Knowlton, and S.D. Kraus. 2004. Visual health assessment of endangered North Atlantic right whales (*Eubalaena glacialis*) using photographs. *Canadian Journal of Zoology* 82:8-19.

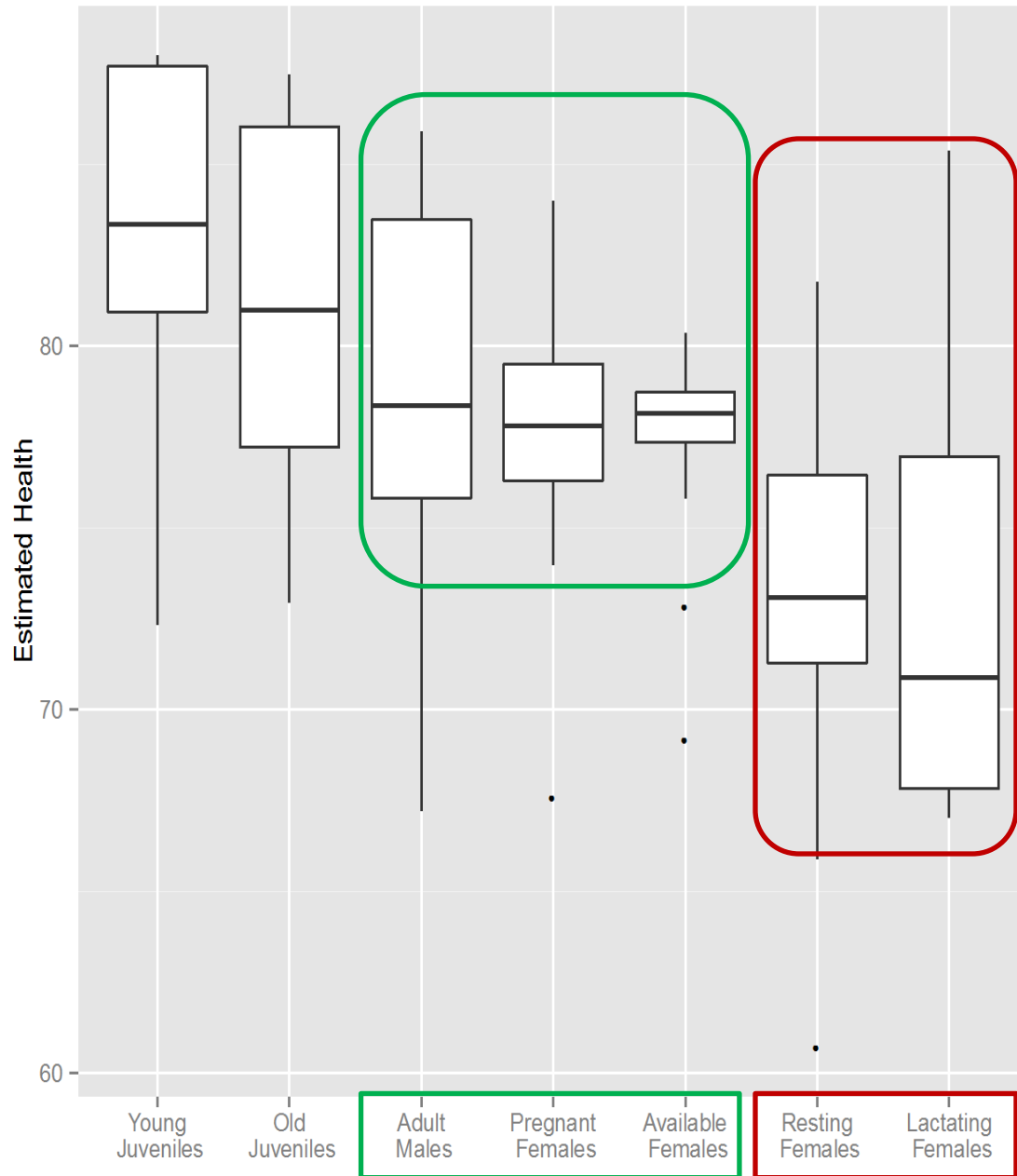
EGNo = 1014



Schick R.S , S.D.Kraus, R.M. Rolland, A.R. Knowlton, P.K. Hamilton, H.M. Pettis, R.D. Kenney, and J.S. Clark. 2013. Using Hierarchical Bayes to Understand Movement, Health, and Survival in the Endangered North Atlantic Right Whale. PLoS ONE 8(6): e64166. doi:10.1371/journal.pone.0064166



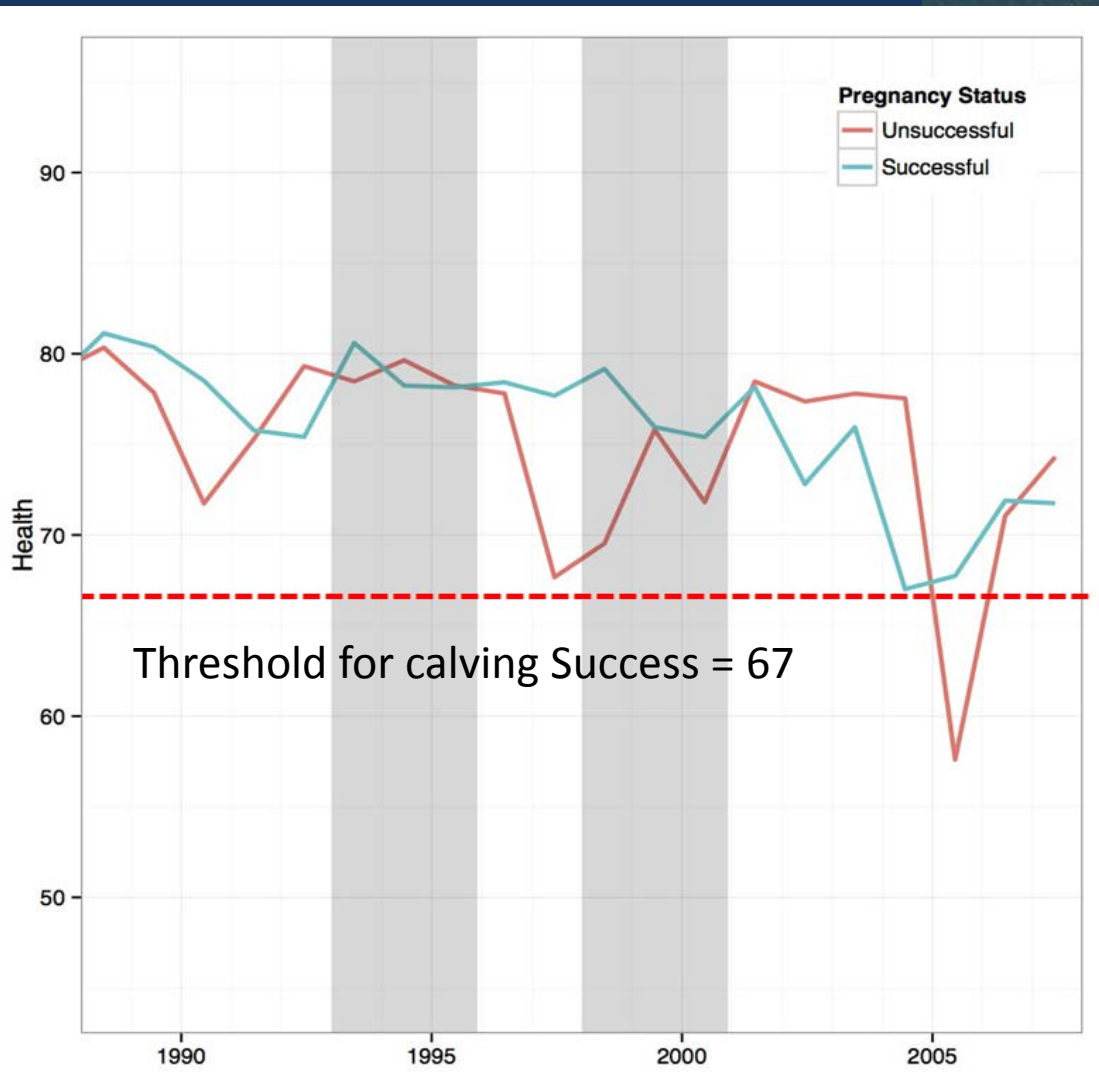
Rolland, R.M., R. S. Schick, H. M. Pettis, A. R. Knowlton, P. K. Hamilton, J. S. Clark, and S. D. Kraus. 2016. Health of North Atlantic right whales, *Eubalaena glacialis*, over three decades: from individual health to demographic and population health trends. *Mar. Ecol. Prog. Series* Vol. 542: 265–282. doi: 10.3354/meps11547



Reproductive females had lower health scores than other demographic groups – reproduction is energetically expensive

Rolland et al. (2016) Health of North Atlantic right whales (*Eubalaena glacialis*) over three decades: from individual health to demographic and population health trends. Marine Ecology Progress Series 542: 265-282

The model results showed that females that calved had a mean health score of 74.55 and those that did not produce a calf had a mean score of 72.96. This difference was significant ($t = 4.787, p < 0.001$), suggesting that small changes in female right whale health may influence reproductive success.



Entanglement Scarring Data used in the Model

Low severity

14 w gear

551 w/o gear



Moderate severity

14 w/gear

108 w/o gear



High severity

25 w/gear

14 w/o gear



Knowlton A.R., P. K. Hamilton, M. K. Marx, H. M. Pettis, S. D. Kraus. 2012. Monitoring North Atlantic right whale *Eubalaena glacialis* entanglement rates: a 30 yr retrospective. *Mar Ecol. Prog. Series* 446:293-302.

Causes of Mortality

Ship Kills



The Lesson from Shipping/Whale Conflicts:

Management can work.

Ships killed at least 21 NARW along the east coast from 1990-2008 (1.166/yr)

Lane changes:

Bay of Fundy, 2003

Boston, 2007

Slowed ship speeds seasonally:

U.S. East Coast U.S. 2008

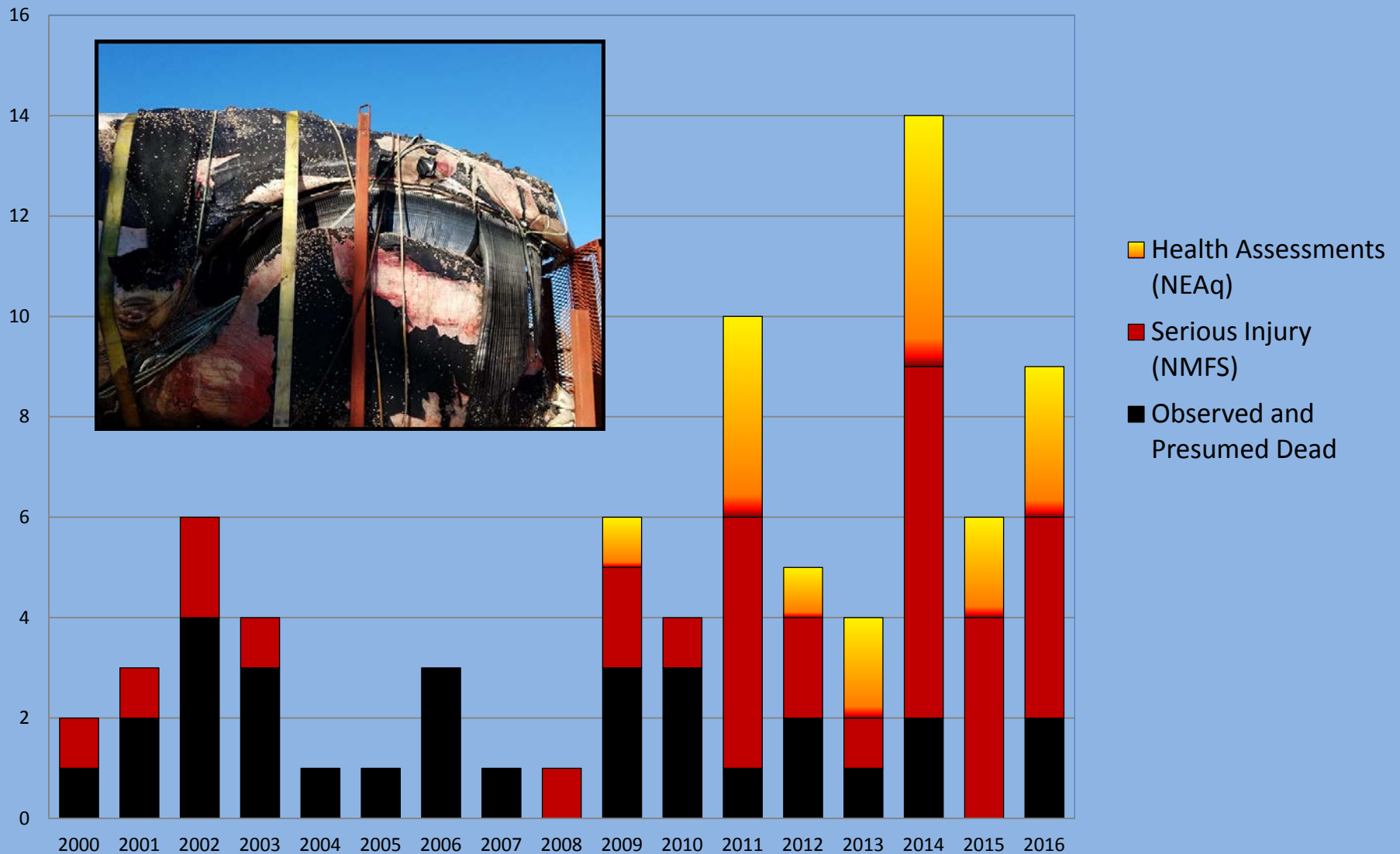
Since these changes, only 3 whales have been killed by ships in U.S waters (0.375/yr)

Laist, D.W., Knowlton, A.R., Pendleton, D. 2014 Effectiveness of mandatory vessel speed limits for protecting North Atlantic right whales. *Endangered Species Research* 23: 133-147.

van der Hoop JM, et al.(2013) Assessment of management to mitigate anthropogenic effects on large whales. *Conserv Biol* 27:121–133

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. *Ecosphere* 4(4):43. <http://dx.doi.org/10.1890/ES13-00004.1>

Right whale mortality estimates from observed dead, presumed dead, and serious injury determinations + uncertain outcomes of seriously injured whales determined by health assessments



Anthropogenic Right Whale Mortality vs Legally Allowable Kills (PBR)



The Conclusion: Rope in the Fishing Industry may represent an existential threat to the survival of North Atlantic right whales

Risk Reduction Options

- Closures in high risk areas
- Change rope color to red/orange
- Reduced Breaking Strength Rope
- Ropeless fishing

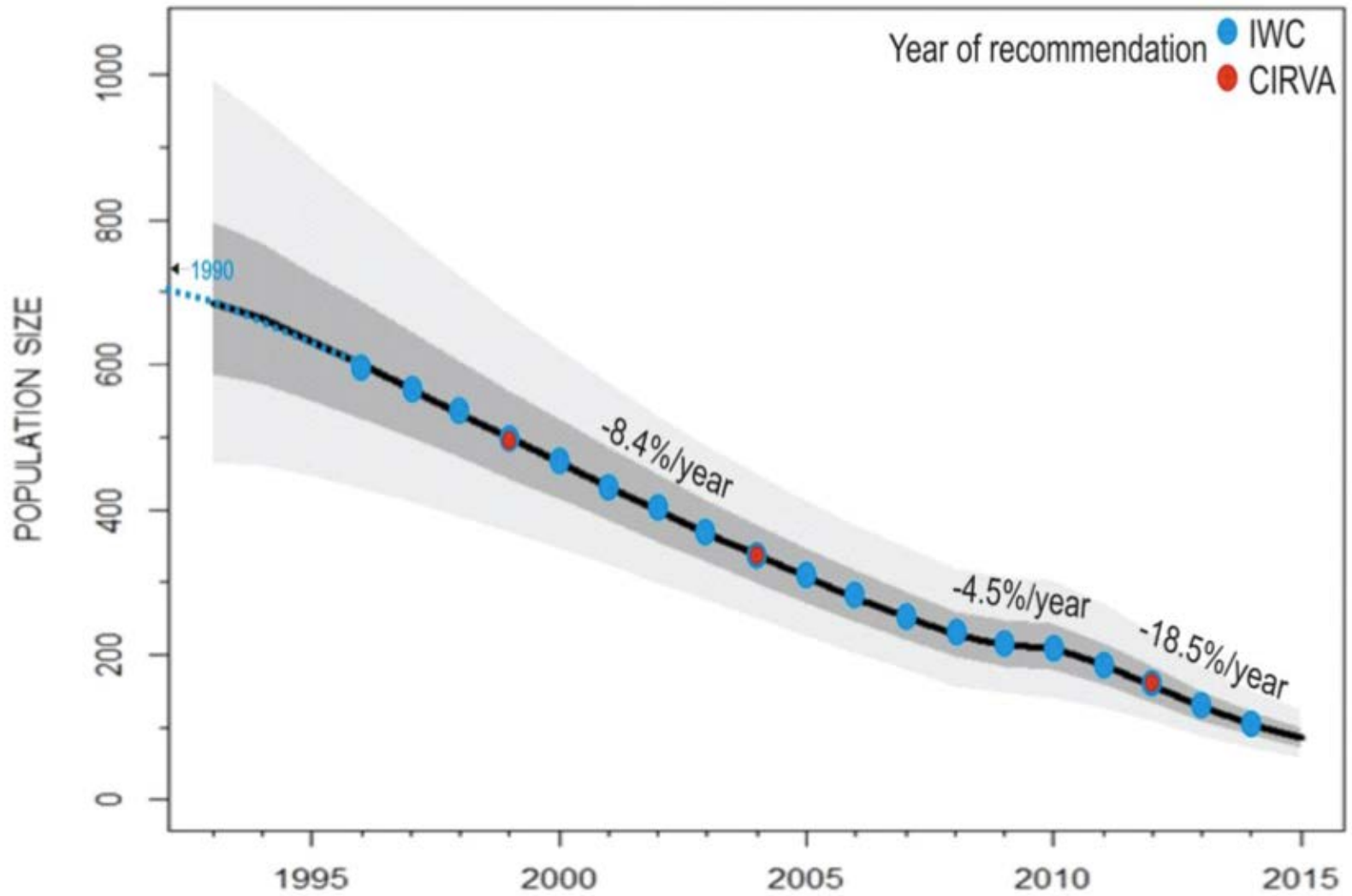
No Longer Viable Options

Managing Co-occurrence of fisheries and whales

- van der Hoop, J. M., Corkeron, P., Henry, A. G., Knowlton, A. R., & Moore, M. J. (2017). Predicting lethal entanglements as a consequence of drag from fishing gear. *Marine pollution bulletin*, 115(1), 91-104.
- van der Hoop, J., Corkeron, P. and Moore, M. (2017), Entanglement is a costly life-history stage in large whales. *Ecology and Evolution*, 7: 92–106. doi: 10.1002/ece3.2615
- Kraus, S. D., R. D. Kenney, C.A. Mayo, W.A. McLellan, M.J. Moore, D.P. Nowacek. 2016. Recent Scientific Publications Cast Doubt on North Atlantic Right Whale Future. *Front. Mar. Sci.* 3:137. doi: 10.3389/fmars.2016.00137
- Knowlton, A.R., J. Robbins, S. Landry, H. A. McKenna, S. D. Kraus, and T. Werner. 2015. Implications of fishing rope strength on the severity of large whale entanglements. *Conservation Biology* doi: 10.1111/cobi.12590.
- Robbins, J., Knowlton, A.R., and Landry, S. (2015). Apparent survival of North Atlantic right whales after entanglement in fishing gear. *Biol. Conserv.* 191, 421–427.
- Pace, R.M. III, Cole, T.V.N., and Henry, A.G. (2014). Incremental fishing gear modifications fail to significantly reduce large whale serious injury rates. *Endang. Spec. Res.* 26, 115–126.



vaquita population trajectory



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