

# Out of sight: how much time do North Atlantic right whales spend within the detection range of visual surveys?

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## KEY FINDINGS

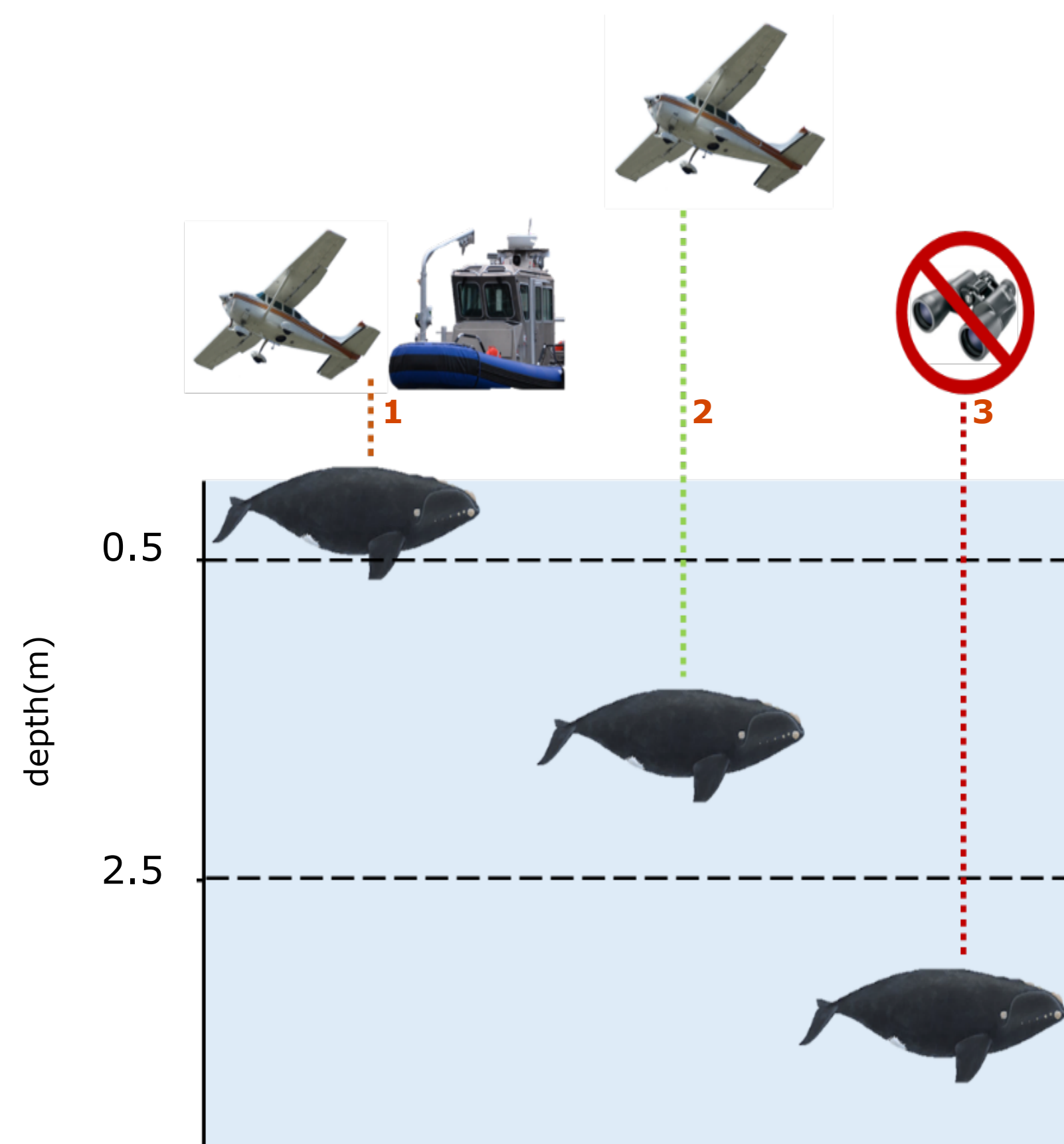
- Pregnant, nursing and juvenile right whales differ in how much time they spend in the detection range of visual surveys due to different factors such as prevalent behavior, calf's presence and buoyance.
- Overall, whales spend more time in the detection range of aerial surveys than boat surveys due to a greater depth for detectability from the air.
- Whales of all age classes spend a low proportion of time at depths where they can be detected by visual surveys and therefore, such surveys may underestimate the abundance of right whales off the southeastern United States.

## MOTIVATION & BACKGROUND

The North Atlantic right whale (NARW, *Eubalaena glacialis*) is a critically endangered species that is consistently monitored along its occurrence range<sup>1</sup>. As part of their normal migratory movements, a portion of the NARW population winters in coastal waters off the states of Florida and Georgia in the southeastern United States (SEUS). Two common visual monitoring methods for NARW surveys off SEUS are aerial and boat surveys.

### FIGURE 1.

Depth ranges at which right whales are available for detection by boat and aerial surveys (1), by aerial surveys only (2) and depths at which they are presumed undetectable by visual methods (3).



### AIM

Quantify the percentage of time in which right whales are detectable by visual survey methods.

**REFERENCES:** <sup>1</sup>Kraus *et al.*, 2005. *Science* 309 (5734):561-562; <sup>2</sup>Available at: <http://rwcatalog.neaq.org/>; <sup>3</sup>Johnson and Tyack, 2003. *IEEE J Ocea Engin* 28 (1):3-12; <sup>4</sup>Cole *et al.*, 2007. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Doc. 07-02; <sup>5</sup>R Development Core Team, 2008. R Foundation for Statistical Computing.

### ABSTRACT

The North Atlantic right whale (NARW - *Eubalaena glacialis*) is a highly endangered species constantly monitored along its occurrence range. Monitoring techniques include passive acoustic systems and visual methods. In order to be detected by visual monitoring methods, whales must remain above a given depth in the water column. For instance, whales must break sea surface to be potentially detected, at a distance, by boat-based surveys (BB) whereas whales above the depth that corresponds to the water transparency, including the ones at the surface, might be detected by aerial-based (AB) surveys. Aiming to quantify the percentage of time in which whales are detectable for visual BB and AB surveys, dive profiles of 14 NARW were analyzed. Tagging operations were conducted during January-March of 2006, 2014-2016 in the SEUS wintering area. Average water transparency for the region was defined as 2.1m and mean tag-on time was 17,741s. Overall whales spent 38.7% of the time at depths  $\leq 2.1$ , 17.1% at the surface and 21.6% between surface and 2.1m. Nursing females (n=6) spend the greatest time in depths  $\leq 2.1$ m (44.3%) where they were detectable by AB surveys and they also spend the greatest time at the surface (21.3%), where they could be detected by both AB and BB surveys. Pregnant females (n=2) and Juveniles (n=4) spend more time at depths where they were detectable exclusively for AB (19.1% and 21.4% respectively) than at the surface (12.4% and 11.2%). Results suggest whales spend more within the detectability range of AB than BB surveys. Even so, whales spend less time in depths where they may be detected by any of the two visual monitoring methods and therefore, visual surveys may underestimate the presence of whales in the SEUS area.

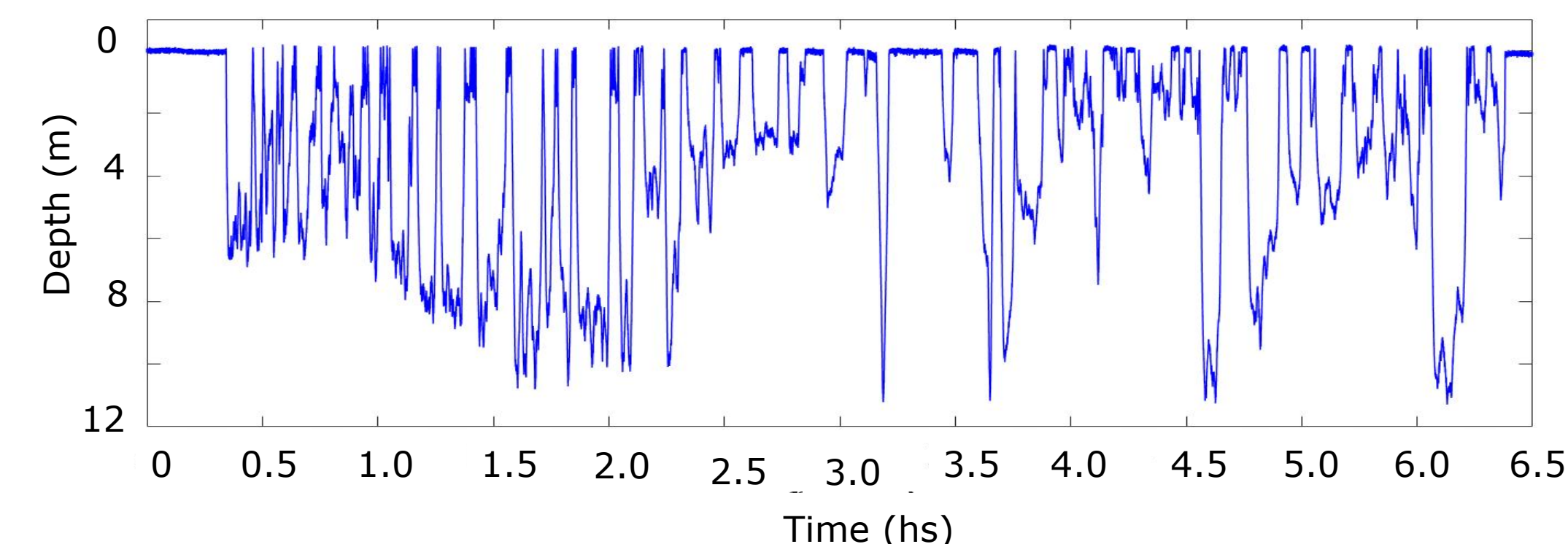
## DATA COLLECTION & ANALYSIS

Tagging operations were conducted in January-February of 2006, 2014-2016 in the SEUS area. Tagged animals were photographed and ids were matched to the NARW catalog for life history details<sup>2</sup>. Adults ( $\geq 9$  years-old) accompanied by a calf ( $< 1$  yo) were considered nursing (presumably females); pregnant whales were adults previously unaccompanied that were subsequently sighted accompanied by a young calf ( $< 1$  yo) (presumably females); whales  $\geq 1$  and  $< 9$  yo were considered juveniles.



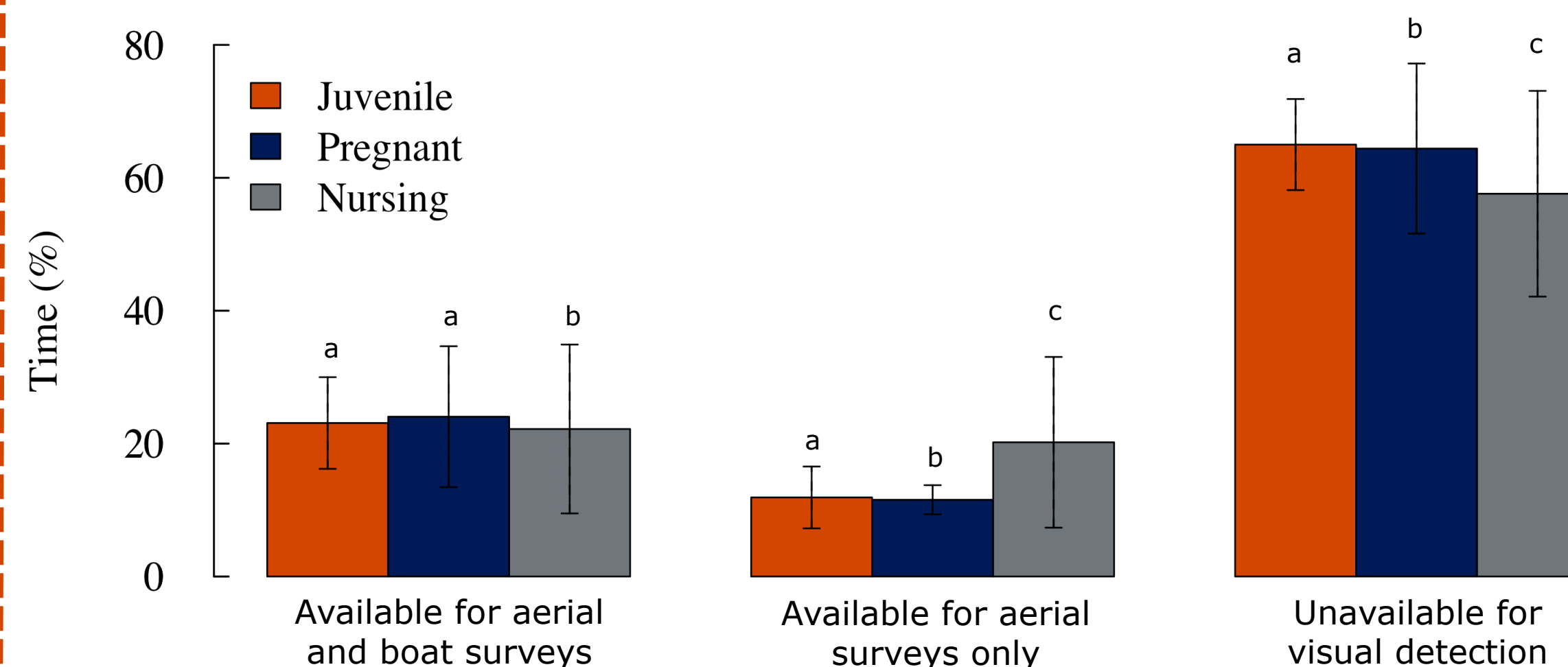
**FIGURE 2.** Suction cup attachment on a North Atlantic right whale subsequently identified as a pregnant female. Photo by Dana Cusano. NMFS permit #14809.

Dive profiles of 15 NARW were obtained from DTAGs<sup>3</sup> pressure sensor ( $\pm 0.5$ m). Threshold for detectability was estimated based on water transparency in the area and visual surveys reports<sup>4</sup>.



**FIGURE 3.** Dive profile of a nursing North Atlantic right whale.

## RESULTS & DISCUSSION



**FIGURE 4.** Letters indicate statistical differences in pairwise-proportion tests for age-class within availability ranges ( $\alpha=0.05$ ). Holm correction was applied to  $p$  values. Analysis conducted using R Software<sup>5</sup>.

Juveniles spend more time unavailable for visual surveys than other age classes. Spending more time at depths greater than 2.5m would benefit travelling animals due to reduced drag. Pregnant females spend less time available for aerial surveys only than others. Variable buoyance will affect how much time they spend at different depth ranges. Nursing females spend more time available only for aerial surveys than other age classes suggesting that the calf's presence limits their time in depths greater than 2.5m.

### FUTURE WORK

Further analysis of dive patterns will clarify behavioral drivers of differences in availability for visual surveys between age classes.

### ACKNOWLEDGMENTS & FUNDING

We would like to acknowledge Duke and Syracuse University staff. Funding was provided by the Office of Naval Research, US Fleet Forces Command and managed by Naval Facilities Engineering Command Atlantic as part of the US Navy's Marine Species Monitoring Program. Data collected under NMFS Permits 14791, 14809.