Influence of environmental conditions on the occurrence, spatial use, & health of bottlenose dolphins in northcentral Gulf of Mexico

Th. Bouveroux[1], C. Diaz Clark[1], J.B. Bloodgood[1], C.S Cloyed[1], M.L. Russell[1], C. Sinclair[2], K. Mullin[2], R.H. Carmichael[1,3]

[1] Dauphin Island Sea Lab, Dauphin Island, Alabama, USA – [2] National Oceanic and Atmospheric Administration, Pascagoula, Mississippi, USA – [3] University of South Alabama, Mobile, Alabama, USA
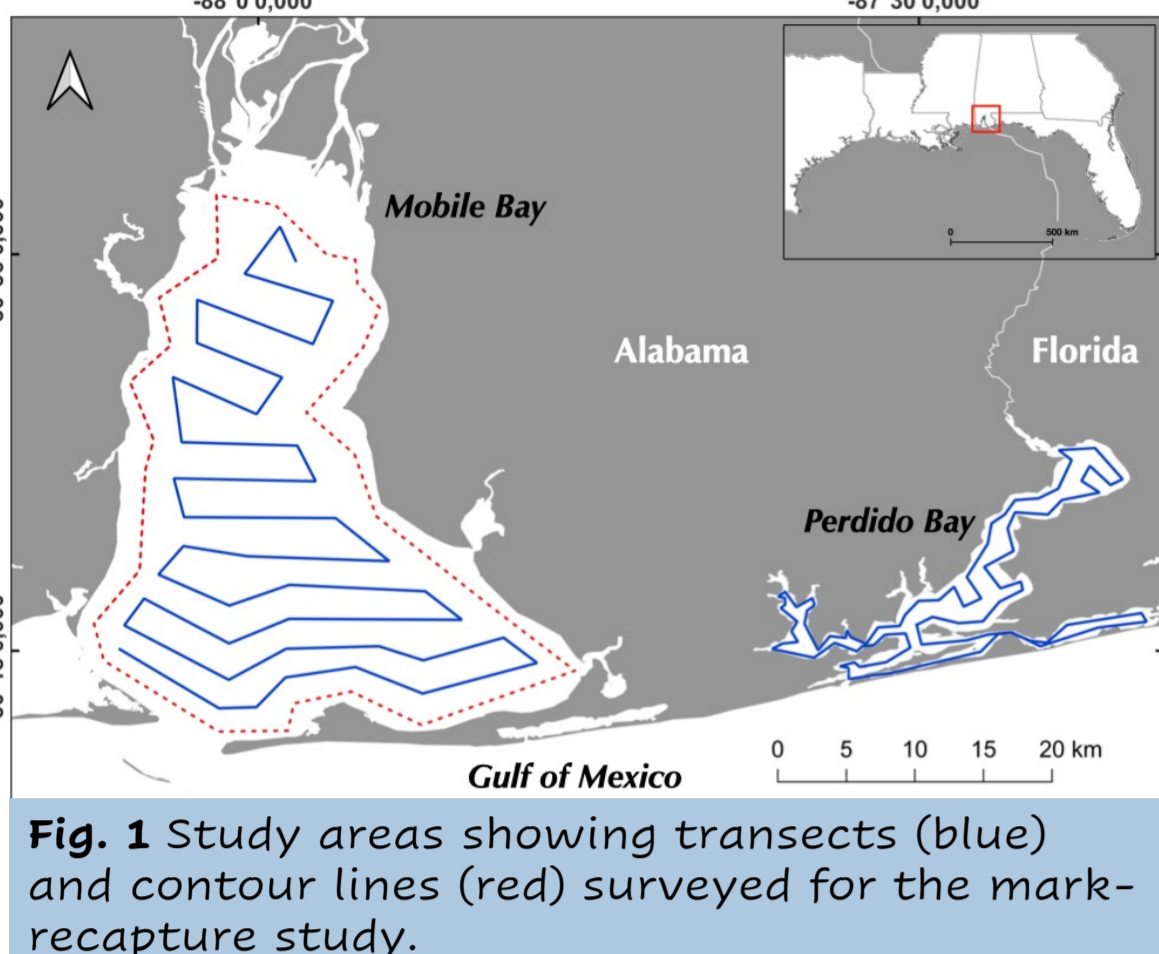
INTRODUCTION

Fig. 1 Study areas showing transects (blue) and contour lines (red) surveyed for the mark-recapture study.

o Mobile Bay (Alabama, USA) is a large, shallow estuary with the 4th largest volume of freshwater discharge in the US (**Fig. 1**).

o Mobile Bay has a poorly studied resident population of common bottlenose dolphins (*Tursiops truncatus*), subject to highly variable environmental conditions (e.g. salinity, dissolved oxygen, water temperature) within their habitat.

o Bottlenose dolphins live in marine ecosystems (salinity > 30 ppt) but can tolerate (extreme) low salinity (< 5 ppt) for short periods. When exposed to longer periods of low salinity, dolphins may develop pathologies such as freshwater skin lesions (FW, pallor & proliferative skin with multifocal erosions and ulcerations), that are frequently observed on live animals and carcasses.

→ **Key population to investigate the effects of changing environmental conditions on dolphin spatial use, group size and health, in a context of climate change.**

OBJECTIVES

o Determine how environmental attributes affect group sizes and the spatio-temporal distribution of dolphins.

o Determine temporal and demographic occurrence of stranded animals showing FW skin lesions in relation to influxes of low salinity and freshwater discharge.

MATERIALS & METHODS

Dolphin surveys

o Capture-mark-recapture dolphin photo-identification (photo-ID) surveys conducted in February 2020, December 2020 & 2021 (winter), and July 2020, June 2021 & 2022 (summer).

o Study area surveyed 3 times in a short time period following transect and contour lines (**Fig. 1**).

Dolphin & environmental data collection

o Number of dolphins, calves & neonates, predominant behaviors, GPS locations, depth & distance to shore recorded for each sighting.

o Salinity, water temperature & dissolved oxygen (DO) sampled at sighting locations using a handled data sonde (YSI 2030).

o High-resolution of salinity, water temperature & DO, sampled every 5s on transects and 30s on focal observations, using a continuous data logging system (© Eureka Water Probes, Dataflow).

o Effects of environmental attributes on group sizes modeled using a Negative Binomial distribution and spatial use from Resource Selection Function models (RSF).

Stranding & water discharge data

o Analyzed stranding data for presence of FW lesions in *T. truncatus* stranded in AL waters.

o Compared stranded dolphins' occurrence to local river discharges and salinity profile between 2016-2020 in AL waters.

Fig. 2 Example of a stranded adult male *T. truncatus* showing severe FW skin lesions (Gulf Shores, AL, 2020).

RESULTS

Groups size, distribution & habitat selection

	Surveys	Sightings	Dolphins	Identified dolphins	Group size
N	85	309	2,494	> 850	1 - 50

o Groups larger in summer (mean ± SD = 9.6 ± 8.8) than winter (6.8 ± 5.5; ANOVA: $F_{1,307} = 11.38$, $p < 0.001$).

o Dolphins mainly observed in the southern part of the bay, in higher salinity but also frequently observed in extreme low salinity waters < 5 ppt (**Fig. 3**).
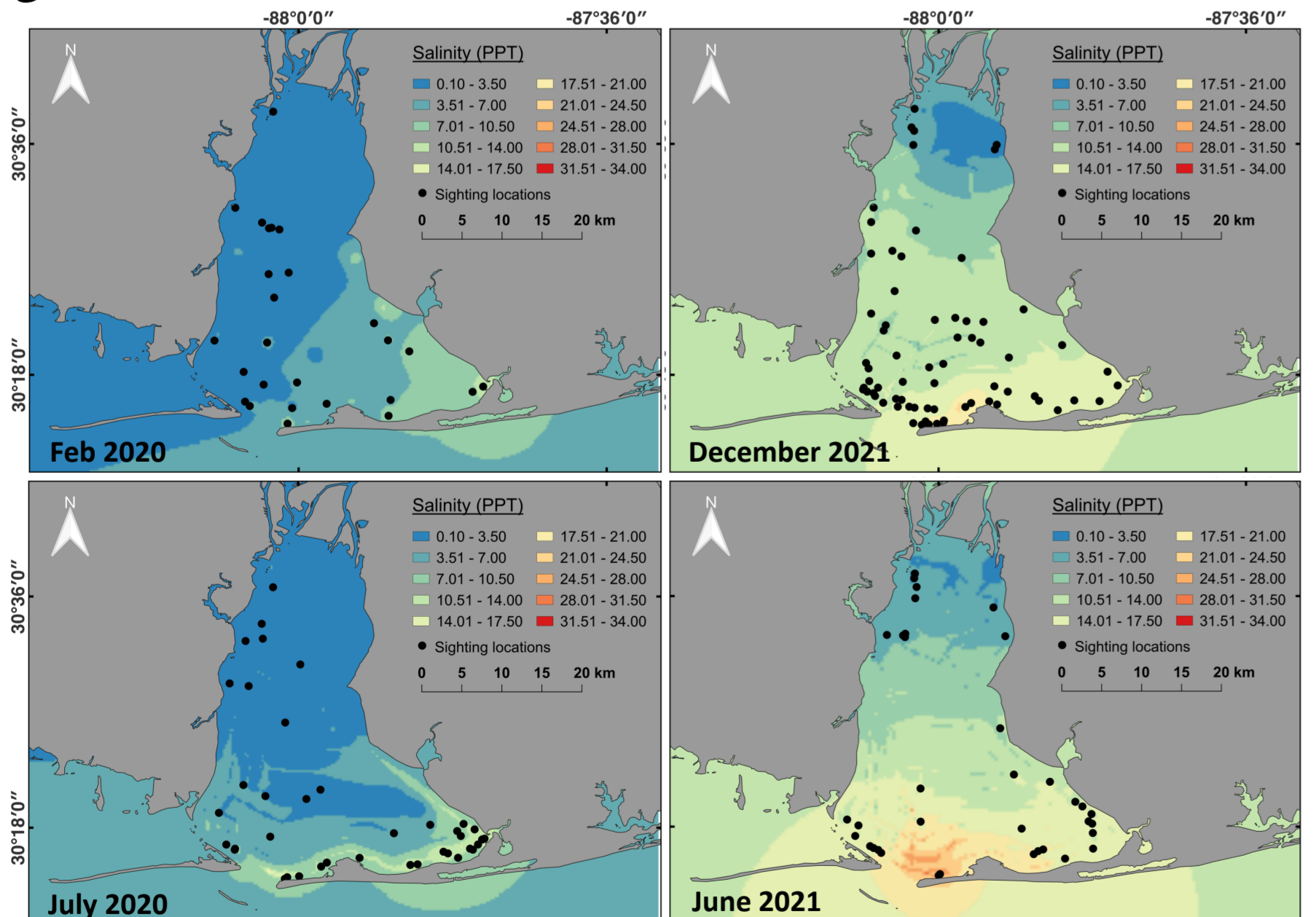

Fig. 3 Example of the salinity profiles collected with the dataflow during mark-recapture surveys. Black dots show the locations of dolphin sightings.

o Salinity did not affect group size ($p = 0.11$).

o Season and distance to shore did significantly affect group size, decreasing in winter ($p = 0.003$) and further offshore ($p < 0.001$).

o In winter, dolphins selected for higher salinity, lower temperatures and deeper locations. In summer, salinity did not affect the distribution of dolphins, but they did select for lower DO and temperatures, and deeper water (**Fig. 4**).
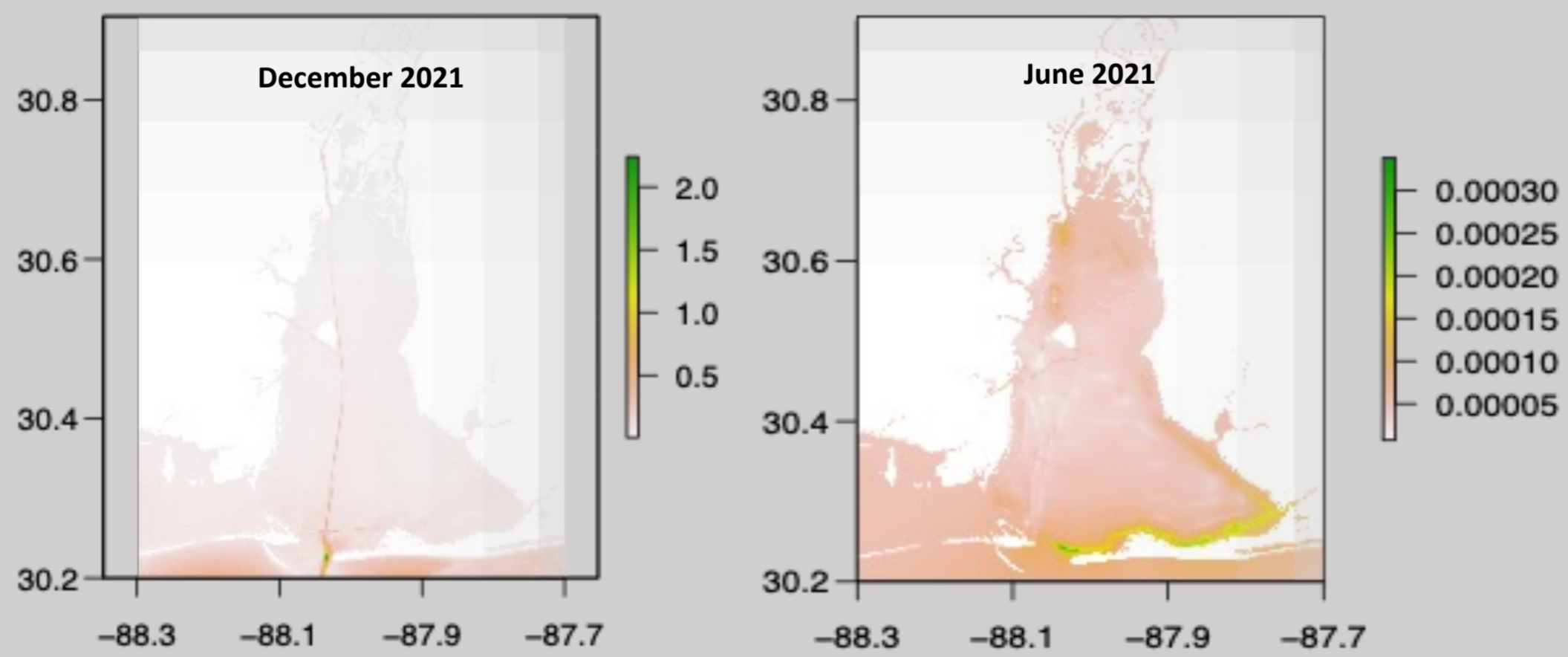

Fig. 4 Example of the seasonal likelihood of dolphin occurrence in Mobile Bay, generated through RSF analyses.

Strandings & salinity

o Higher stranding occurrence between February and April (50.22 %, n = 114, **Fig 5**).

o Subadults more frequently stranded than other size classes (**Fig. 5**), but females and fetuses stranded most frequently during calving season (January - April).
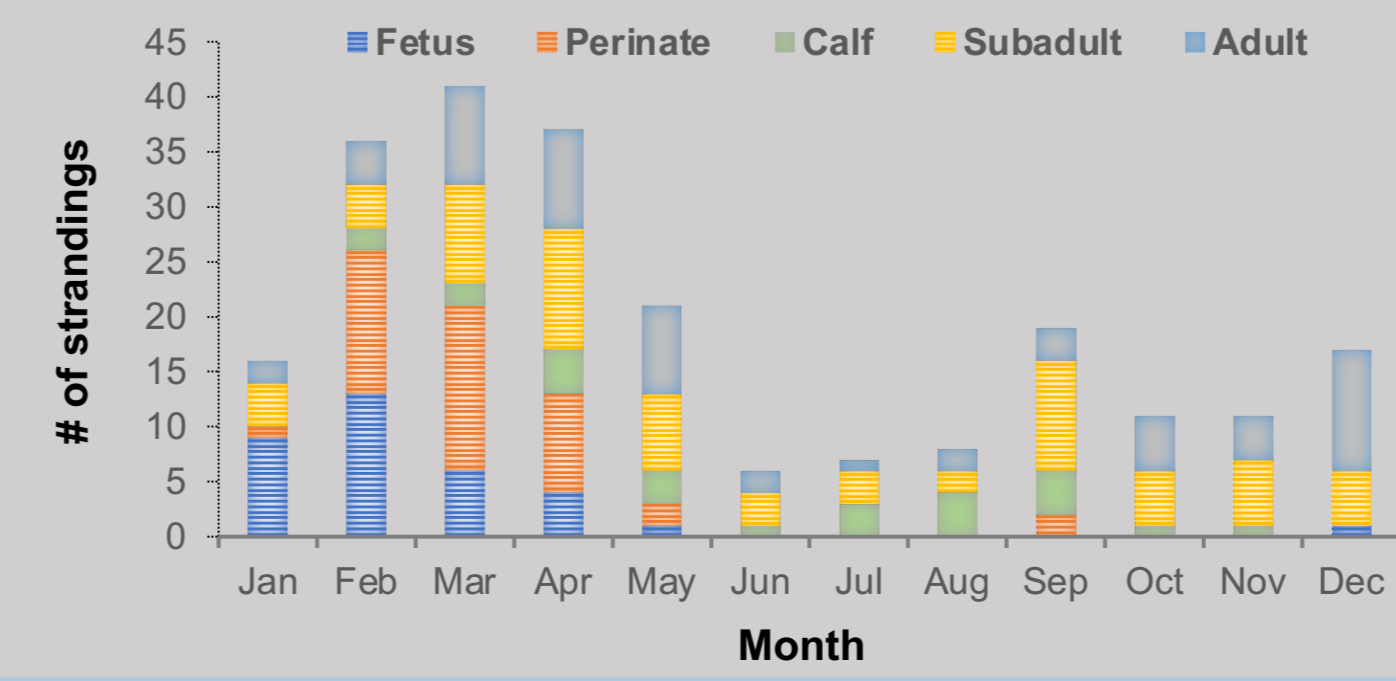

Fig. 5 Temporal and demographic trends of stranding occurrence (n = 227, data 2008-2018).

o Adults with FW lesions stranded significantly more frequently between 2016 and 2020 than other size classes ($p < 0.01$, **Fig. 6**), but no significant difference between sexes ($p = 0.83$).
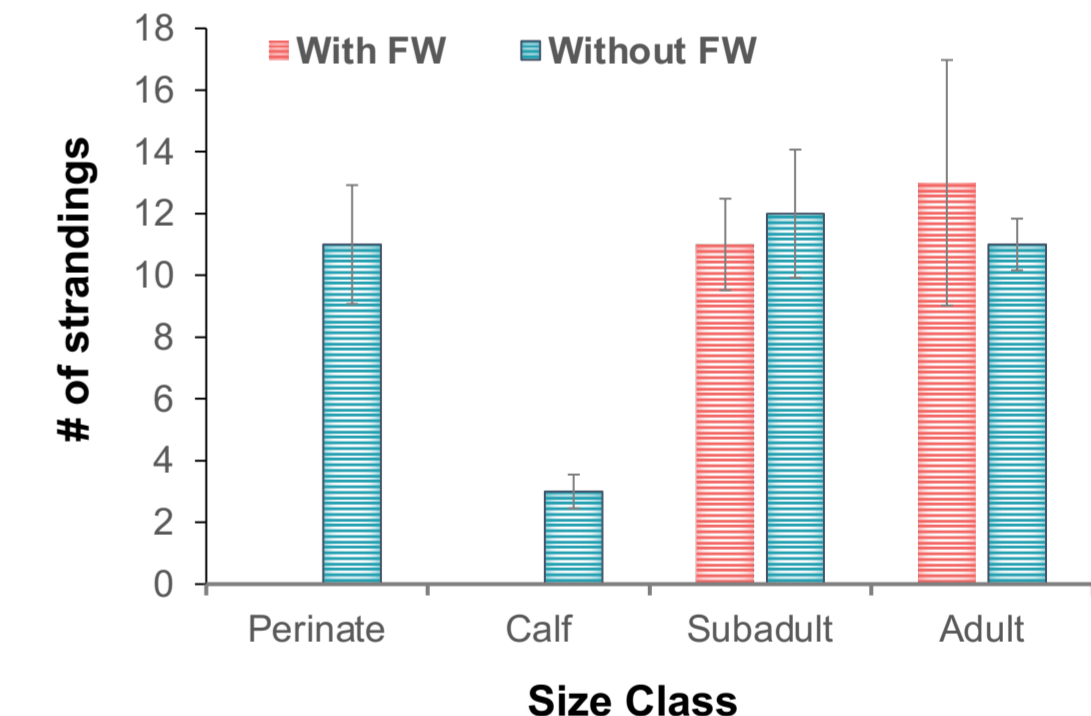

Fig. 6 Demographic occurrence of FW lesions in strandings (data 2016-2020).

o Salinity dropped when discharge increased (**Fig. 7**), which then caused an increase in the occurrence of stranded animals with FW lesions (41%, n = 25) around these periods, particularly in 2020.
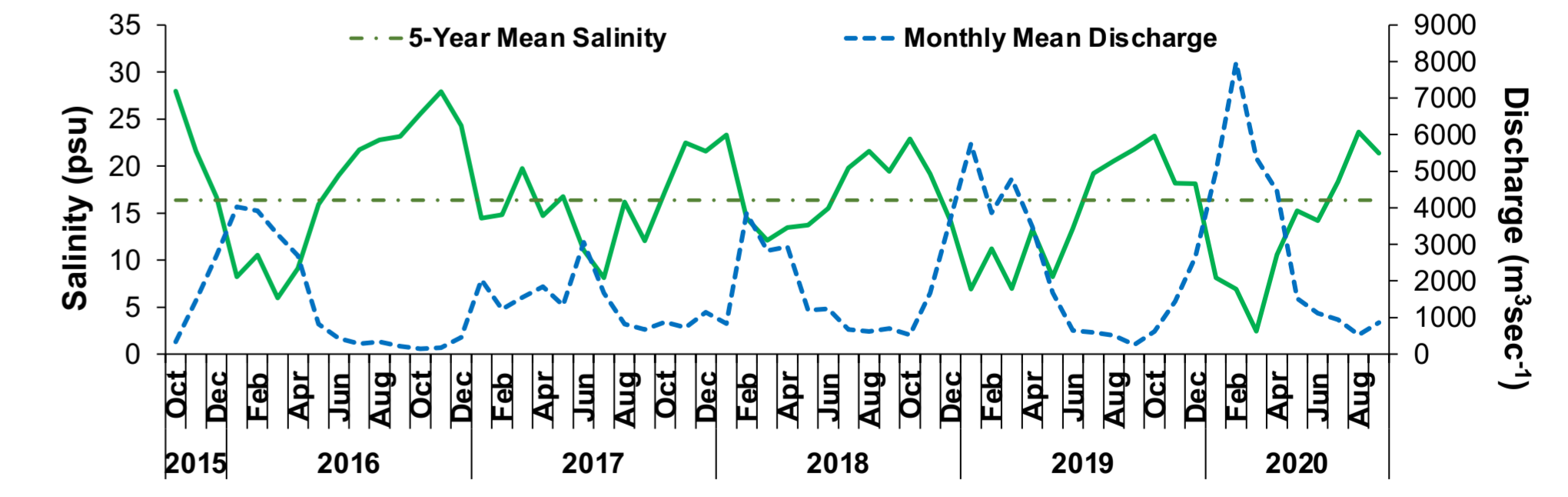

Fig. 7 Temporal trends of salinity and freshwater discharge in Mobile Bay (data 2016–2020)

CONCLUSION - Salinity fluctuates seasonally in Mobile Bay but it does not explain variations in group size. In winter, group sizes are smaller, and dolphins select higher salinity locations. In summer, groups are larger, and water temperature, DO, & depth are the main ecological drivers for habitat selection of dolphins. Strandings of animals with FW lesions occur more frequently after periods of high discharge, resulting in lower salinity waters, mostly targeting adult & subadult dolphins.