## Bottlenose dolphins (*Tursiops truncatus*) kill harbor porpoises (*Phocoena phocoena*): evidence from the central California stranding record, 2007-2023.

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## Introduction

Harbor porpoise (*Phocoena phocoeana*) populations in California have grown at rates of approximately 6-10% since 2004, the post-gillnet bycatch period (Forney et al. 2021). Despite this growth, there exist concerns about emerging threats. One such concern is attack by bottlenose dolphins (*Tursiops truncatus*).

A recognized phenomenon worldwide (e.g. Gross et al. 2020), instances of interspecific aggression were first noted in California at the time of the “unusual mortality event” (UME) of 2007-2009. Wilkin et al. (2012) examined stranded carcasses of harbor porpoises collected during this period and identified blunt force trauma as the most common known cause of death. Injuries in these cases suggested attack by bottlenose dolphins. Cotter et al. (2012) observed attacks in Monterey Bay during this same period, providing further evidence of porpicide. Both authors indicated that these types of attacks peaked in the late summer and fall.

In this study we reviewed the harbor porpoise stranding record in central California from the time of the UME reported by Wilkin et al. (2012) to the present, estimating the probability of porpicide (i.e. attack by bottlenose dolphin) in each case.

## Methods

* Stranding network
  + range of search area and protocol for reporting and collecting carcasses
* Pathology
  + process for necropsy and assessing TME data
  + process for estimating probability
    - Confirmed Case: Tt rakes + Fractures + Hemorrhage +/- Capture Myopathy
    - Probable Case: Fractures + Hemorrhage +/- Capture Myopathy
    - Suspect Case: Hemorrhage +/- Capture Myopathy
    - Unlikely Case: Sudden death without blunt or sharp force trauma.

## Results & Discussion

### Interannual variability

The number of cases each year depends on mortality and to a large extent on other factors, such as the probability that carcasses will float to shore and that they will be found. This causes variability year to year in the data set. There is a significant increase in cases coincident with the beginning of the UME in 2008 (Wilkin 2012). This is all shown in [Figure 1](#fig-yearly-counts).

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| Figure 1: Yearly counts are variable due to a combination of influences. |

Normalizing for interannual variability, we see that evidence of porpicide was most prevalent among strandings in 2015-2020. This trend appears to have reversed over the past 3 years as depicted in [Figure 2](#fig-prop-porp).

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| Figure 2: Incidence of porpicide appears to increase, then plateau 2015-2020, before decreasing again in recent years. |

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### Seasonal variability

As seen in [Figure 3](#fig-monthly-counts) there is seasonal cycle in strandings. Most occur in the summer. This is consistent with Wilkin et al. (2012) who observed the same patterns in stranding data from 1998-2010.

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| Figure 3: Cumulative number of strandings, by month, for the period 2007-2023. Shows most strandings occur during the Summer. |

Porpicide cases appear to peak later in the year, in the late-summer to fall. [Figure 4](#fig-monthly-probs) shows that, normalizing for monthly variability, porpicide cases form the greatest proportion of strandings in July-October.

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| Figure 4: Proportion of strandings in each probability class, by month. These proportions are derived from the 18 year period Jan 2007- Dec 2023 |

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### Spatial extent

The northward range expansion of bottlenose dolphins (cit. needed) could drive a higher incidence of porpicide in northern regions through time. An initial look at the spatial data [Figure 5](#fig-spat-conf) does not reveal any obvious northward progression in confirmed porpicide cases.

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| Figure 5: Spatial extent of confirmed porpicide cases does not show any chronological trends, such as a northward progression which may have been the effect of range expansion documented in California bottlenose dolphins. |

If confirmed cases are compared to unconfirmed cases, a weak northward trend may appear. The maximum latitude of all confirmed cases in a given year appears to increase through time, particularly if compared to all unlikely cases. See Figure 6.

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| Figure 6: The maximum latitude of strandings exhibits a weak northwards trend for high-likelihood porpicide cases, especially when compared to low-likelihood cases. |

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### Age/sex of porpicides

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| Figure 7: Adult females and juvenile males appear to be the most frequent targets among confirmed cases of porpicide. |

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## References

Cotter, Mark P., Daniela Maldini, and Thomas A. Jefferson. 2012. “‘Porpicide’ in California: Killing of Harbor Porpoises ( *Phocoena Phocoena* ) by Coastal Bottlenose Dolphins ( *Tursiops Truncatus* ).” *Marine Mammal Science* 28 (1). <https://doi.org/10.1111/j.1748-7692.2011.00474.x>.

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