

Killer Whale Predation as the Cause of Death in Gray Whales, Alaska Case Review

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Presented at Alaska Marine Science Symposium, January 23, 2023

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INTRODUCTION

Since December 2018, increased mortalities of eastern North Pacific gray whales (*Eschrichtius robustus*) have been documented along the west coast of North America, from Mexico to Alaska. In May 2019, NOAA Fisheries declared the rise in the number of strandings (i.e., mortalities) an Unusual Mortality Event (UME), which persisted throughout 2022.

A central goal of the UME investigative process includes the evaluation of potential causes of mortality. Most gray whales migrate almost 20,000 km round-trip between their breeding and calving grounds in the warm waters off Baja Mexico, through the coastal waters of California, Oregon, Washington, and British Columbia, to their feeding grounds in high-latitude cooler waters spanning from the northern regions of British Columbia to Arctic Alaska. These areas also fall within the range of Bigg's (or transient) killer whales (*Orcinus orca*), known predators of large cetaceans, including gray whales. The overlap of ranges is extensive and predation events have been documented throughout the migratory corridor, breeding grounds, and feeding areas (Lowry et al. 1987; Melnikov & Zagrebin 2005; Matkin et al. 2007; Ford & Reeves 2008; Barrett-Lennard et al. 2011; Matkin & Durban 2013; Willoughby et al. 2022).

MATERIALS AND METHODS

Case Definition Development

While information on killer whale predation is not uncommon in the literature, no established protocol has been available to consistently evaluate killer whale predation as a cause of death (COD). Consequently, before killer whale predation could be assessed, a Case Definition was created.

Goal:

To formulate defensible criteria in a case definition format for the evaluation of killer whale predation as cause of death in gray whale.

A literature review and conference with experts provided descriptions of killer whale predatory behavior and consequently on lesions associated with killer whale attack. The five most common lesions included:

1. Missing tongue/jaw
2. Peeled skin/blubber
3. Semi-lunar bite wounds (tissue defects)
4. Broken bones and/or contusions
5. Tooth impressions ("rake marks")

Each was then subjected to the following considerations:

- **Mortality** – is the lesion likely to cause death?
- **Observability** – is the lesion externally visible?
- **Specificity** – is the lesion specific to killer whale predation?

The considerations listed above established a weight of evidence and allowed for lesions, observed either in person or through imagery, to be assigned one of five levels of certainty relative to the likelihood of killer whale predation as the COD: confirmed, probable, suspected, improbable, or could not be determined (CBD).

Table 1. Qualities of lesions most commonly associated with killer whale predation.

✗ = criterion not met ✓ = criterion minimally met ✓✓ = criterion strongly met

LESION	MORTAL?	OBSERVABLE?	SPECIFIC?
1. Missing tongue/jaw	✓✓	✓	✓✓
2. Peeled blubber/skin	✓	✓	✓
3. Bite wounds, tissue defects	✓	✓	✓
4. Broken bones, contusions	✓	✗	✗
5. Rake marks	✗	✓	✓✓



Figure 1. Missing tongue, semi-lunar bite wound, and bone contusion.



Figure 2. Peeled skin/blubber

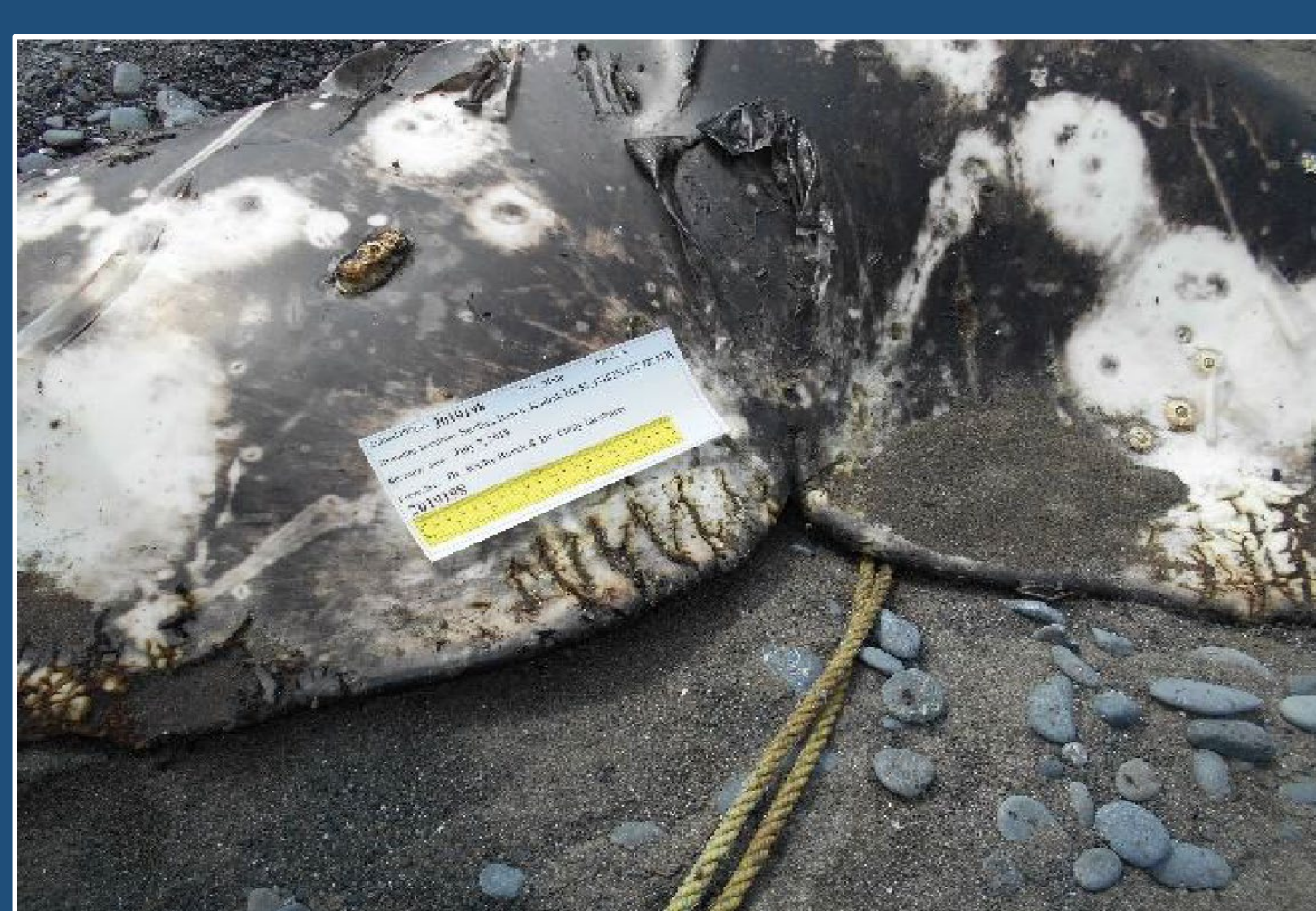


Figure 3. Fresh rake marks (left) indicating recent predation event as opposed to healed and healing rake marks (right) indicating historical event.



2015 – 2022 Case Review

- A review team of four marine mammal biologists used the Case Definition to evaluate photographs of Alaska gray whale stranding reports: 63 from 2015-2018 (pre-UME) and 131 from 2019-2022 (UME).
- Reviewers determined the likelihood of killer whale predation as the COD in Alaska gray whales and classified as confirmed, probable, suspect, improbable, or could not be determined (CBD). A confirmed report includes an eye-witnessed predation event and identified carcass. None of the years evaluated included a confirmed report.
- If an evaluation was not unanimous then either the majority was adopted or, in the case of a tie, the most conservative evaluation was chosen, e.g. suspected rather than probable.
- Factors that precluded assessment, i.e. CBD, included:
 1. Advanced decomposition, scavenging, and/or insufficient or low-quality imagery.
 2. Other factors (e.g., differentials) precluded assessment and/or lead to significant uncertainty.

RESULTS

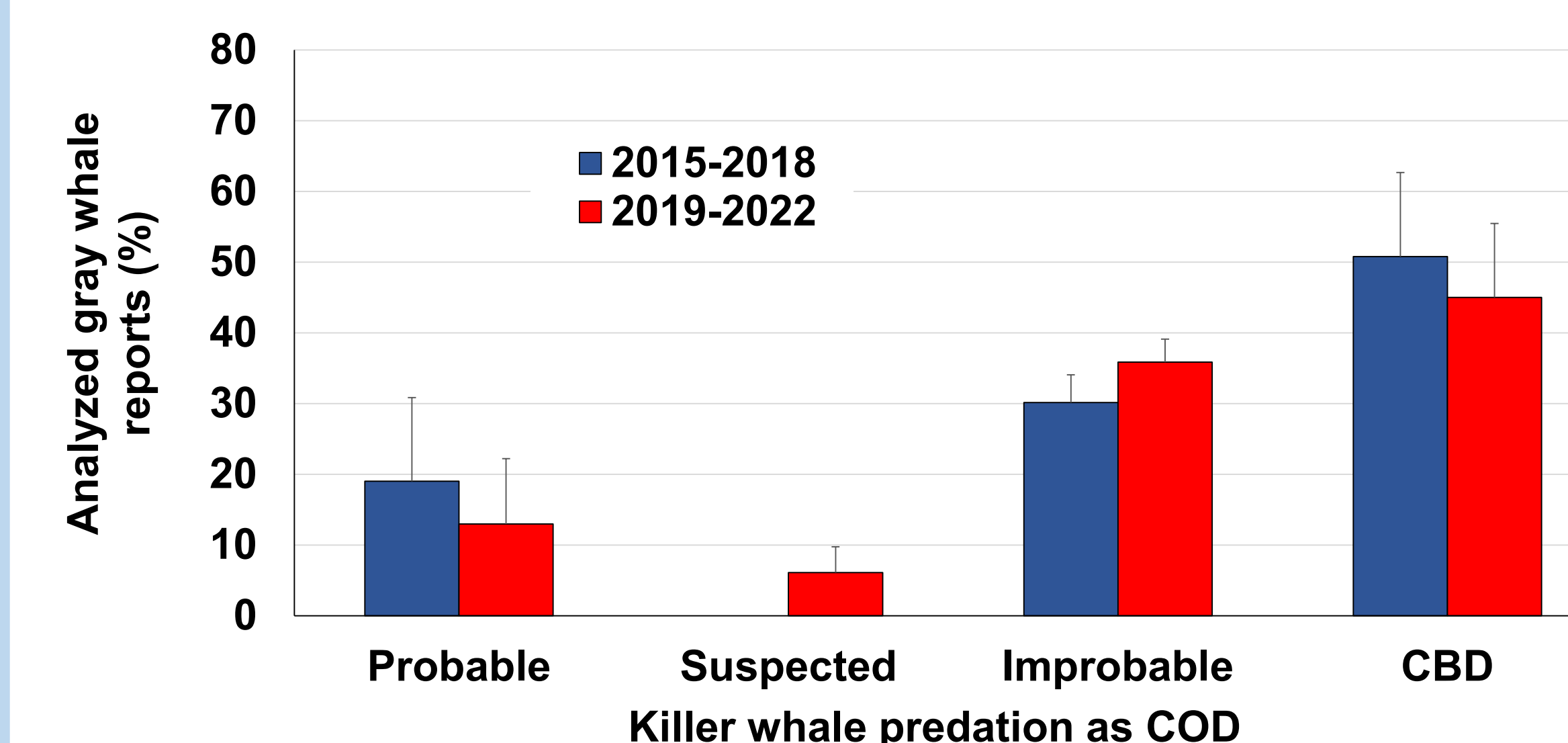


Figure 4: Percentage of each killer whale predation as COD likelihood determination using the new case definition for gray whale strandings in Alaska, pre (2015-2018) and post (2019-2022) gray whale UME designation.

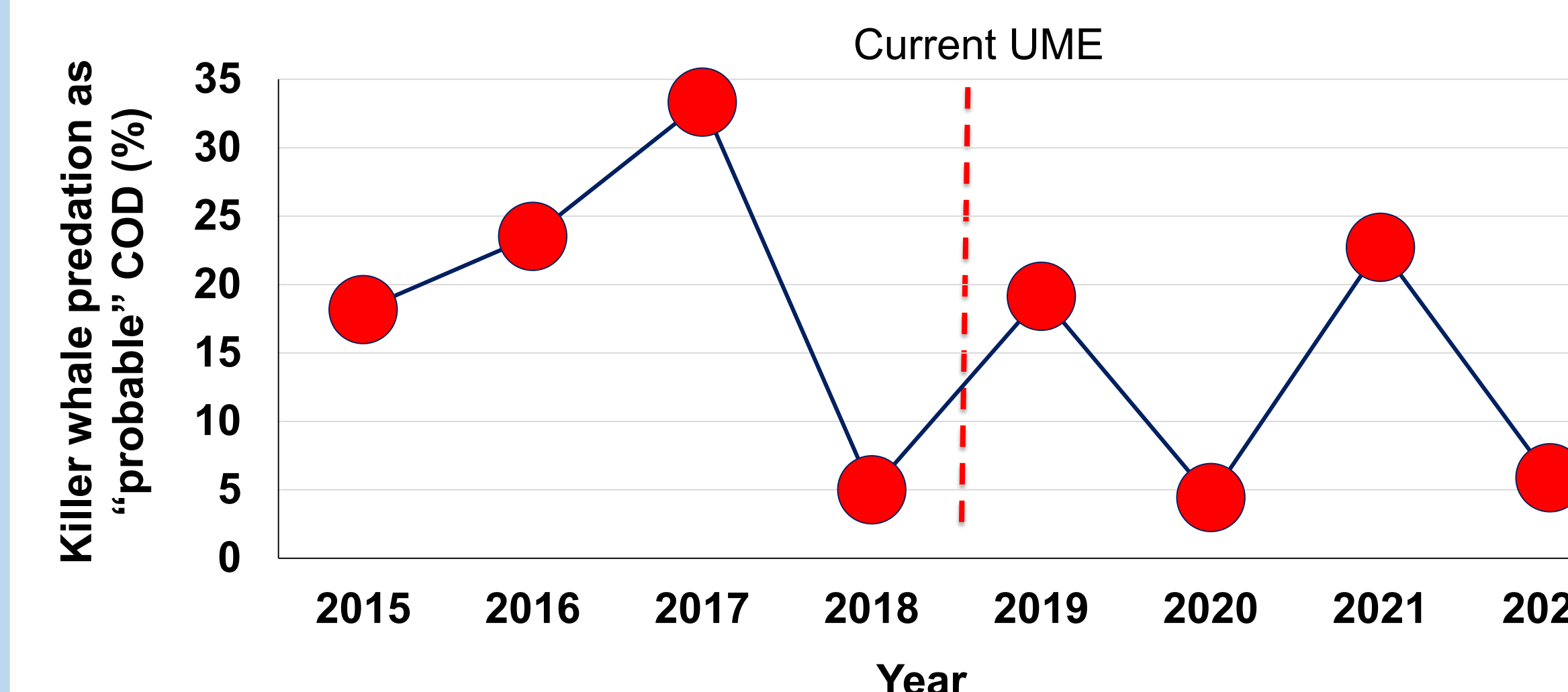


Figure 5: Percentage, by year 2015-2022, of Alaskan gray whale reports analyzed using the new case definition with a "probable" determination that killer whale predation was COD.

CONCLUSION

- The Case Definition was a consistent and defensible method to evaluate photographs for the likelihood of killer whale predation as COD in gray whales. The Case Definition may be useful in expanding the analyses of killer whale predation as COD to the entire gray whale migratory pathway or as applied to other large whale species.
- An increase in killer whale predation was not the likely cause of increased gray whale strandings in Alaska during the current UME.

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ACKNOWLEDGEMENTS

A special note of thanks to: ❖ Lance Barrett-Lennard, Jon Ford, Craig Matkin ❖ Kerri Danil, Pdraig Duignan, Moe Flannery, Jessie Huggins, Stephen Raverty, Jim Rice, Gay Sheffield, Raphaela Stimmelmayer, Amy Willoughby ❖ Deb Fauquier and the AKR Stranding Network